

**CDC 4E051**

# **Public Health Journeyman**

**Volume 2.**

**Disease Recognition and Control**



**Air Force Institute for Advanced Distributed Learning**

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**Author:** SSgt Robb Gudgel  
USAFSAM/AETD  
USAF School of Aerospace Medicine  
2602 West Gate Road  
Brooks Air Force Base, Texas 78235  
DSN: DSN 240-3731  
E-mail address: robert.gudgel@brooks.af.mil

**Instructional Systems**

**Specialist:** Emily A. Rome

**Editor:** Connie E. Cooper

Air Force Institute for Advanced Distributed Learning  
Air University (AETC)  
Maxwell Air Force Base, Gunter Annex, Alabama 36118–5643

THIS VOLUME CONTAINS information concerning disease recognition and control. Unit 1, Principles of Epidemiology, is a study of diseases and the procedures for performing disease outbreak investigations. Unit 2 explains the different types of communicable diseases, the way they are transmitted, and the control measures necessary for each type of disease. Unit 3 spans the medical entomology program giving the purpose of the program and public health's responsibilities. You will read about different vectors of disease and some of the pests commonly found on bases. Some of the Public Health responsibilities are mosquito surveillance and establishing a baseline survey, as well as knowing the necessary control measures for the medical entomology program.

Code numbers on figures are for preparing agency identification only.

A glossary of abbreviations and acronyms is included at the end of this volume.

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This volume is valued at 24 hours and 8 points.

**NOTE:**

In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then do the unit review exercises.

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## **Student Notes**

# Unit 1. Principles of Epidemiology

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**E**PIDEMIOLOGY is the study of the various factors that determine the frequency and distribution of diseases in populations. For example, epidemiology is concerned with such things as how often diseases occur in a population, how many people are affected, and where do the diseases occur? Epidemiology uses this information to understand the causes of diseases and the best ways to prevent them. In the Air Force, Public Health performs these epidemiology functions.

There is no single cause for any disease. The simple presence of disease agents (bacteria, viruses, fungi, etc.) in the environment is not enough to explain disease outbreaks. For example, *Clostridium botulinum*, the disease agent involved in botulism, is generally present everywhere in our daily environment. However, an outbreak occurs only when several conditions are met. To prevent and control human diseases that are caused by infectious agents, you must understand how disease agents exist in nature, the means by which they reach humans, and how humans and agents interact. You will learn these principles of infectious disease epidemiology in this unit.

## 1–1. Communicable Disease Process

To understand any communicable disease process, you must know the relationships between the host and the disease agent. Let's take a brief look at some of these.

### 201. Host-agent relationships

A host is a person or other living animal, including birds and arthropods, that is harboring a disease agent. Some agents, such as protozoa and helminth, pass through successive stages of development while in two or more different species of hosts.

#### Host

To understand the relationship between host and agent better, let's consider diphyllbothriasis. Diphyllbothriasis is a tapeworm disease in humans.

#### The cycle

The cycle of diphyllbothriasis begins when an infected human excretes tapeworm eggs. The eggs are discharged into fresh water, where they hatch and infect small shellfish. The small shellfish are eaten by susceptible fish, and then the tapeworm larvae undergo another stage of development within the fish. A human catches this fish and eats it raw or undercooked. The larval tapeworms develop to maturity in this human and start producing more eggs to start the cycle over again.

***The name of the host***

In this instance of tapeworm disease, the human is called the *primary* or *definitive host*, because the tapeworm attains its maturity and goes through its sexual or reproductive stage in the human. The shellfish and freshwater fish are called the *secondary* or *intermediate hosts* because the tapeworm is in larval stages while in these animals.

***The host as a carrier***

The host of the disease can be a “carrier.” A carrier is a person or animal that harbors a disease agent, but has no clinical signs of the disease. The carrier is a potential source of infection to others. The carrier state may last for a lifetime, as in the case of Typhoid Mary. On the other hand, it may last for only a few weeks, as often happens with carriers of poliovirus, diphtheria, bacilli, or streptococci. In investigating outbreaks of disease due to agents that can cause carrier states, finding the source of infection may be difficult since the host will not appear to be ill.

**Agent**

Infectious disease agents are organisms that live on or in the body of a host and that can produce disease or illness.

***Agent locations***

All living organisms carry disease agents on or in themselves. Almost any location on the host’s body may be occupied by disease agents. For example, viruses and some bacteria invade and multiply right within the very cells of the host.

***Agent differences***

Different agents have different abilities to produce disease in particular hosts. These differences are often described in terms of infectivity, pathogenicity, and virulence.

***Infectivity***

Infectivity is the ability of the agent to invade and multiply, or to produce infection, in a host. The chicken pox and measles viruses are very infective, easily infecting a susceptible host. On the other hand, the bacteria causing tuberculosis and leprosy are not very infective. Long, intimate exposure to an infected person is required before a second person becomes infected; and then the infection does not always lead to disease.

***Pathogenicity***

Pathogenicity is the ability of an agent to produce clinical disease in a host. Some agents, such as the measles virus, produces disease in virtually all infected persons. These agents are highly pathogenic. Other agents, such as the polio virus, produce disease in only a small percentage of infected individuals. Such agents have low pathogenicity. Agents also vary in the severity of the disease they cause.

***Virulence***

Virulence is defined as “the proportion of clinical cases resulting in severe clinical manifestations.” Rabies produces severe and usually fatal manifestations. Thus, the rabies virus is highly virulent. Upper respiratory viruses generally produce much less severe diseases. Therefore, these viruses have low virulence.

### Agent types

There are many types of organisms, and you need to know some of their characteristics. Specifically, you need to know about the types of organisms that include disease agents and cause illness.

#### Metazoa

Metazoa are multicellular organisms, often referred to as parasites. Metazoa that cause infection or disease include nematodes (roundworms), trematodes (flukes and flatworms), and cestodes (tapeworms). These organisms are capable of causing disease in both animals and humans.

#### Protozoa

Protozoa are single-celled, animal-like organisms. Most are free-living and found in soil and water. A few parasitic protozoa cause disease; for example, *Entamoeba* and *Giardia* are usually waterborne or foodborne and cause diarrhea. *Plasmodium*, the agent that causes malaria, is normally transmitted by mosquitoes and causes fever, anemia, and death. *Pneumocystis carinii* infection results in a severe or fatal pneumonia in AIDS patients. *Trichomonas* is a protozoa transmitted by sexual contact, which causes persistent infections in the genital tracts of both males and females.

#### Fungi

Fungi are found almost everywhere. There are about 80,000 fungi species. Only a few of the fungi species cause disease. The two forms of fungi, as shown in figure 1-1, are single cell (yeast) and multicellular (molds).

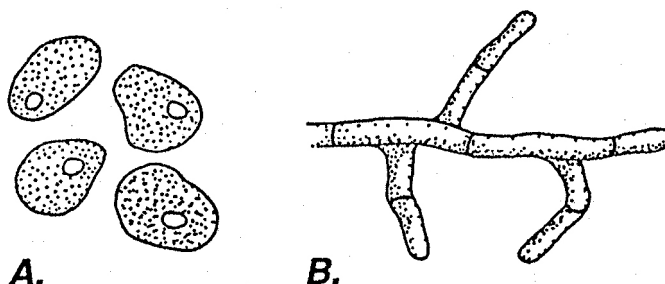


Figure 1-1. Fungi.

Some fungi, usually those that cause disease, can live in either form and are called biphasic (two phases) or dimorphic (two forms). *Histoplasma* and *Coccidioides* are examples of dimorphic fungi. Fungal diseases can be limited to the skin or mucous membranes (superficial), occur in deeper tissues, or involve the entire body (systemic). Ringworm is a superficial fungal infection (not a true worm), while *Histoplasma* results in a deep-seated or systemic infection.

#### Bacteria

Bacteria are microscopic single-celled organisms appearing in variations of three different shapes: bacillus (rod), coccus (sphere), and spirillum (spiral). Although many are capable of causing disease, most bacteria are beneficial. They perform important functions such as fermentation of foods (beer, cheese, buttermilk), digestion of raw sewage, and protection against disease-causing bacteria. In fact, the bacteria normally found in human intestines aid in the digestion of nutrients and prevent the growth of some dangerous bacteria. Examples of disease causing bacteria are *shigella*, a bacillus; *Staphylococcus aureus*, a coccus; and *Vibrio cholerae*, a spirillum. They are illustrated in figure 1-2.

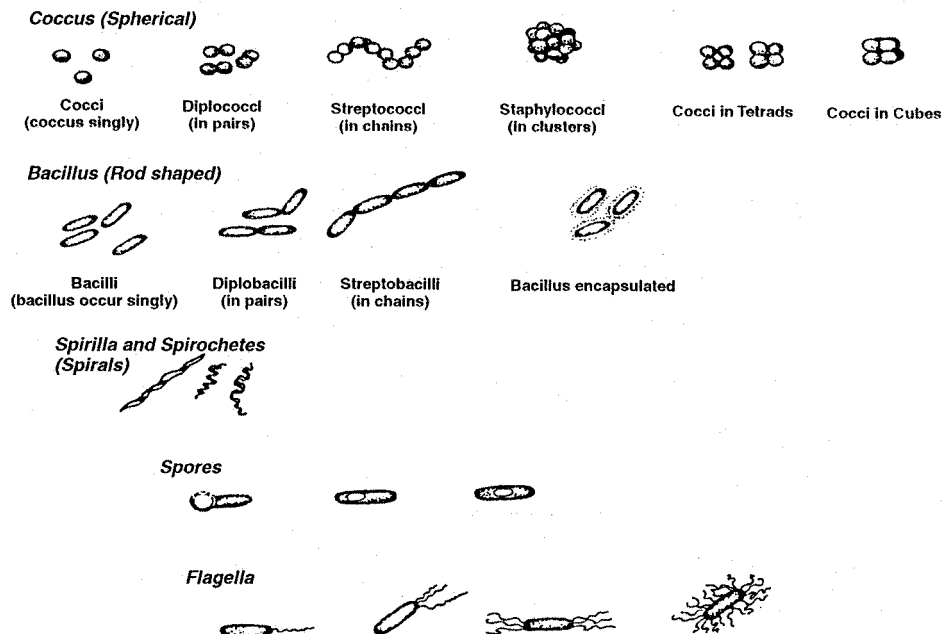


Figure 1-2. Bacteria.

### *Rickettsia*

*Rickettsia* are small bacteria; however, they do not have all the characteristics of typical bacterial cells. Most are obligate intracellular parasites; that is, they must live within living cells. Many rickettsial diseases are spread by arthropods. For example, Rocky Mountain spotted fever is caused by *Rickettsia rickettsii* which are transmitted by ticks. Typhus is spread by mites, lice, and fleas. *Chlamydia*, which are also classified in the rickettsia group, are also intracellular parasites and cause a variety of diseases, most notably the sexually transmitted disease chlamydia.

### Viruses

Viruses are particles of nucleic acid (either DNA or RNA) surrounded by a protein sheath; they are highly infectious (fig. 1-3A). Mature virus particles, called virions, must infect and use a living cell for energy production and replication (fig. 1-3B). Common diseases like hepatitis, measles, rubella, and influenza are caused by viruses.

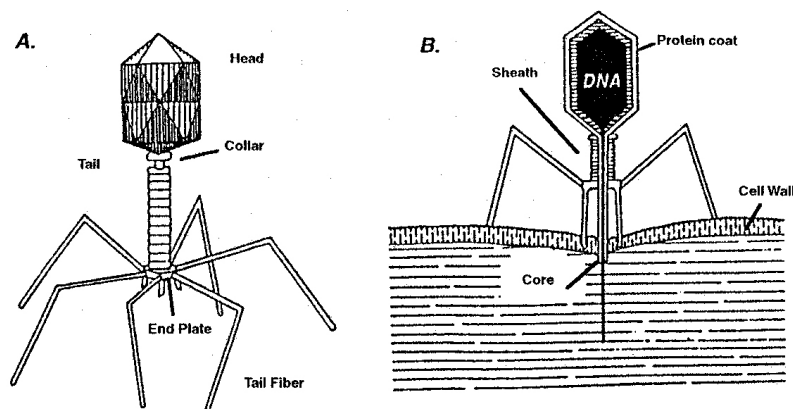


Figure 1-3. Viruses.

**Host-agent interaction**

When a host comes in contact with a disease agent, there are three possible outcomes:

1. Nowhere to lodge —  
The disease agent may not be able to penetrate the host's body, or if it penetrates it is not able to lodge anywhere before being eliminated.
2. No effect —  
The agent may enter and lodge in the host's body, but cause no symptoms of disease.
3. Great effect —  
The disease agent may lodge, multiply, and cause signs and symptoms of disease.

**Agents enter the body**

In humans and higher animals, microbial disease agents normally enter the body by ingestion, inhalation, or penetration.

***Ingestion***

The agent may be swallowed, ingested with food or drink, or introduced by putting fingers, cigarettes, or other materials in the mouth.

***Inhalation***

The agent may be inhaled along with air.

***Penetration***

The agent may penetrate the skin by entering through a cut or an insect bite, etc.

**Agents in the body**

Once in the body, the disease agent finds the right place to live.

***Where to live***

Most disease agents can only live in a certain type of cell or organ. These are called the agent's "target cell" or "target organ." For example, some agents live in the intestines, while others live in the blood or in the respiratory tract.

***Raising a family***

The agent must be able to reproduce for survival. Some tapeworms lay about a million fertilized eggs. Why so many? Species survival depends on it!

***Leaving home***

The young disease agents must be able to exit the target organ and survive outside of the host until they enter a new host.

## 202. The chain of infection

Communicable diseases are those diseases that are transmittable among various hosts. They may result from close or direct contact with an infected person or animal; from exposure to the breath, cough, or bodily discharges (sputum, mucus, urine feces) of such a person or animal; from foods, liquids, or articles contaminated by an infected person or animal; or from the bites of humans or animals. You know about organisms, such as viruses, rickettsia, protozoa, fungi, and bacteria, that cause communicable diseases. Most of these organisms are too small to be seen without a microscope. Some of them survive only a few minutes outside the human body, whereas others survive for years in the general environment. When these infectious organisms enter the human body and begin to multiply or reproduce, they may cause communicable diseases. The chain of infection describes how these disease agents are spread.

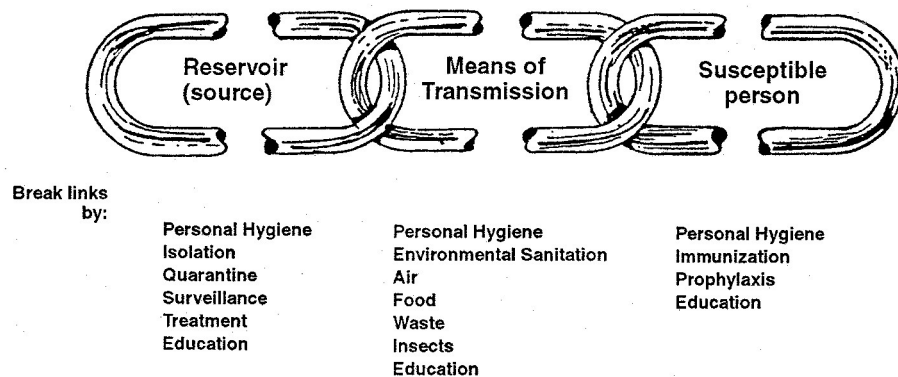


Figure 1-4. Chain of infection.

### The chain

Communicable diseases result from an orderly progression of events. This series of events may be explained using a three-link chain. Each link represents a factor, or set of factors, essential to the transmission of disease. These links are the source, mode of transmission, and host. If any one of the links in the chain is broken, as shown in figure 1-4, the disease cannot spread.

### Source

The source or reservoir of the disease agent.

### Mode

The mode of transmission is the means by which the disease agent may be transmitted.

### Host

A susceptible person or host.

### Source of disease agent

The source of a disease agent is the person, animal, inanimate object, or substance from which the infectious agent passes to a host.

### Person

If the source is a person, the person may be either a case or a carrier.

### Case

A case is a person who is actually ill with a disease.

### *Carrier*

As discussed earlier, carriers are people who harbor disease organisms, but are not ill. Carriers can spread germs in the same manner as cases; however, carriers are more dangerous because they may not know they are harboring and spreading infectious organisms.

### *Animal*

Animals also may be sources of infection. They may be ill with disease, or harbor an organism, without showing signs of illness, much like human carriers.

### *Inanimate*

In some cases, the source of the infectious agent is not a living organism; it may be some inanimate object. For example, soil may be the source of a number of disease agents including those from the *Clostridia* genus that cause botulism and tetanus.

## **Means of disease transmission**

The *means of transmission* link in the chain of infection is how the infectious agent gets from a source to a susceptible individual. There is a variety of mechanisms by which an infectious agent can be spread from a source to a host. These mechanisms include both direct and indirect transmission.

### *Direct transmission*

Direct transmission is essentially the immediate transfer of infectious agents to a portal in which infection may take place.

#### *Direct contact*

Diseases such as rabies and gonorrhea are transferred or spread by direct contact. This transfer occurs by direct contact such as touching, biting, kissing, or sexual intercourse.

#### *Contact with droplets*

Diseases such as measles, *Haemophilus meningitis*, and influenza are transmitted by contact with droplets of spray. Transmission may occur by close contact with droplets of spray onto the mucous membranes of the eyes, nose, or mouth during sneezing, coughing, spitting, singing, or talking. This type of direct spread is usually limited to a distance of 3 feet, or less.

### *Indirect transmission*

Transmission can occur through indirect means such as vehicleborne, vectorborne, and airborne ways.

#### *Vehicleborne transmission*

Transmission of a vehicleborne infection is indirect because the infection occurs without direct exposure or contact with the reservoir (ill person). The infection occurs as a host or susceptible person comes in contact with contaminated inanimate objects (fomites) or materials. Vehicles may include toys, handkerchiefs, soiled bedding or clothes, cooking utensils, water, food, milk, blood, body fluids, tissues, or organs.

#### *Vectorborne transmission*

Vectorborne diseases are divided into two categories, mechanical and biological.

1. Mechanical.

Crawling or flying insects, such as roaches or filth flies, can spread diseases mechanically by carrying disease organisms on their feet or proboscis (mouth parts). Disease may also be spread mechanically by organisms passing through insect intestinal tract to a susceptible host.

## 2. Biological.

In diseases spread biologically, the organism must multiply (propagation), undergo further development (cyclic), or both (cyclopropagative) before the arthropod can transmit the infective form of the agent to humans. Biological transmission is different from mechanical in that the arthropod itself is infected with the organism.

### *Airborne transmission*

The disease is airborne-transmitted by the dissemination of microbes or microbial particles in the air to a suitable portal, usually the respiratory tract. The microbes or particles may stay in the air for long periods of time, some retaining their infectivity and others losing their infectivity.

“Droplet nuclei” are a microbial aerosol that result from evaporation of fluid from droplets expelled from an infected host. Droplet nuclei remain in the air for long periods of time; diseases such as tuberculosis are transmitted by droplet nuclei. Transmission also may occur from airborne dusts, such as fungal spores, that have been separated from the soil by the wind.

### **Susceptible person**

A susceptible (or nonimmune person) is one who has little or no resistance to a particular organism, and if exposed to this organism, is likely to contract infection or disease. By contrast, an immune person is one who has a high degree of resistance to the organism, and when exposed, does not develop the infection or disease. In some cases, immunity to a disease is relative and can be overwhelmed by exposure to a very large number of the disease organisms.

### **Breaking the chain**

If the chain of infection can be identified, prevention and control measures can be used to break one or more of the links. In order to use prevention and control measures effectively, you must know the characteristics of the disease agent, means of transmission, and susceptible persons. As you will see, all control measures do not work equally well for all diseases. Measures may be best used against one particular link; or prevention and control measures may have to be used against two or more links to break the chain of infection.

### **Source**

Measures to control or prevent infection at the source include diagnosis, treatment, isolation, destruction of the source, and education.

### *Diagnosis and treatment*

Diagnosis and treatment of the source or case not only resolves the infection in the source patient, but also may prevent its spreading to others.

### *Isolation*

There are no treatments for diseases such as hepatitis B, AIDS, and rabies, so other measures must be considered. Therefore, in some cases, it may be necessary to isolate the patient from others.

### *Destroy the source*

An alternative to isolation is killing or destroying the source. This may include sterilizing or disinfecting equipment, materials, or surfaces.

### *Education*

Patient education is a very important control measure to break the source link. Patients may be taught the significance of infection, the importance of taking medication, the means to avoid reinfection, and how to prevent the spread to others. For example, a crucial part of tuberculosis control is convincing the patient to take medication daily for 6 to 12 months.

***Means of transmission***

Prevention and control measures used to break this link may include preventing contact with the source (direct contact transmission) or vehicle. Measures such as environmental sanitation, water treatment, food hygiene, and waste treatment, control the spread of agents through the vehicles of water, milk, and food. Vector control minimizes the spread of disease. As with measures directed against the source of infection, prevention and control efforts against the means of transmission must be appropriate. For example, it is not feasible to kill all mosquitoes carrying malaria at a deployment site. Area spraying may reduce the numbers, but will not prevent infection. Thus, other measures are used for the susceptible person such as insect repellent, bed nets, and chemoprophylaxis (e.g., malaria pills). Also, it would be inappropriate to restrict hepatitis B or human immunodeficiency virus (HIV) carriers from foodhandler duties, since the viruses are not spread by food.

***Susceptible person***

Immunization, prophylaxis, and education are some of the prevention and control measures used to break this link. Again, the measures must be suitable for the particular disease and the susceptible person or population. For example, you couldn't immunize someone to protect them from malaria because there is no vaccine for that disease. Vaccines are not available for many other diseases, so education becomes important. Our communicable disease programs emphasize education as a means of disease prevention. Field sanitation briefings, squadron AIDS presentations, and individual counseling of STD patients are all a means to break this link by training personnel how to avoid the source, avoid the means of transmission, or minimize their susceptibility.

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**Self-Test Questions**

After you complete these questions, you may check your answers at the end of the unit.

**201. Host-agent relationships**

1. What is the definition of the term "host"?
2. What is the definition of the term "carrier"?
3. What are infectious disease agents?
4. What is infectivity?

5. What is pathogenicity?
6. When a host comes in contact with a disease agent, what are the three possible outcomes?
7. What are the three main modes of entry used by disease agents to get into the body?

## **202. The chain of infection**

1. What are the three parts of the chain of infection?
2. What may serve as a source of infection?
3. What are the four ways disease agents may be transmitted from the source to a susceptible individual?
4. How may the chain of infection be broken at each link?

## **1–2. Factors Affecting Disease Occurrence**

Why do we get sick? Why do some people get sick, while others do not? Many of us ask these questions when someone we know gets sick or dies. There are a number of factors involved with the occurrence of disease. In this section you'll learn some of these factors. First, let us consider the body defenses.

### **203. Host factors**

The human body has a number of defenses. The intact skin and mucous membranes provide the body with a protective covering against living agents and many chemicals. Other structures such as the hair, sweat glands, and fat pads help to protect the body against physical forces and aid in thermal regulation. Our eyes wink and blink, and our tears have a cleansing action thus providing protection against objects or pathogens. The skeleton protects the delicate vital organs such as the brain, heart, lungs, and abdominal organs. The abdominal cavity is well lubricated so the organs will slide out of line of direct pressure and sharp objects. Coughing and sneezing are efforts of the respiratory system to get rid of harmful substances. The cilia within the upper respiratory tract constantly beat to move a layer of mucous with trapped particles to the outside. Vomiting and diarrhea are defense mechanisms of the gastrointestinal tract; and the kidney and liver filter out or detoxify various chemicals.

**General body defenses**

The body has internal defenses against disease agents, such as bacteria, that are able to gain access to the body. For example, inflammation is a defense mechanism used by the body to wall off and destroy harmful agents. Numerous white blood cells (WBC) go to the scene of an infection to surround and engulf the agents. Pathogens are moved via lymph channels to lymph nodes, which are filter-like structures lined with WBCs. Even if these fail and the pathogens get into the blood stream, large filters with white blood cells located in the bone marrow, liver, and spleen will take over the defense.

**Intrinsic factors**

When investigating the occurrence of a disease, age, gender, and race are often the first things you need to determine. These *host characteristics* are often associated with disease occurrence. These characteristics may be involved with the degree of exposure to a disease agent. Also, persons of different ages, sexes, or races may differ in susceptibility to certain agents. Furthermore, age, gender, or ethnic group may affect specific immunity in the population at risk.

***Age***

Young children's defense mechanisms against disease are poorly developed. This is the reason for the high mortality rates in infants less than 1 year old, especially in developing countries. Their immune systems just cannot fight disease organisms as well as an adult or older child. As we get older, our defense mechanisms are more developed and stronger. But we also start coming in contact with more people and things that are the sources of disease. At first, we are allowed to play in our own yard; as we get older, we can play across the street, and in the neighborhood. At five or six, we start school, and each stage of our life brings us in contact with new people and places. We develop immunity to many diseases such as measles, poliomyelitis, and chickenpox as children and are protected for life. As we reach the later years of our lives, our defense system starts to weaken, and we are more susceptible to disease again.

***Gender***

Gender affects the distribution of disease due to anatomical differences, hormonal factors, and exposure potential. Older men frequently develop prostate infections. Women do not have a prostate and so, obviously, do not get prostate infections. Urinary bladder infections are more common in females than males because of the different anatomy of the urinary tract. Estrogen, a female hormone, seems to protect against some diseases such as heart disease and osteoporosis. These are just a few examples of sex differences.

***Race***

You can probably already think of some examples of disease differences between the races, such as sickle cell anemia in persons of African and Southern Mediterranean derivation. Did you also know tuberculosis is more of a problem in those same persons? Diabetes is common in Jewish males. Some of the reasons for these differences are known, and others are just theories. The differences may be due to exposure potential, differences in immunity, or other defense systems.

**General health status of host**

In addition to the structural and functional aspects of the human body, the general health status of the host is a significant factor in disease occurrence. The general health status of the host includes his or her physiological state, nutritional status, pre-existing disease, and stress.

***Physiologic state***

Physiologic state can affect occurrence of disease in a number of ways. For example, pregnancy enhances the risk of certain diseases such as urinary tract infections. Also, women lose the protective effect of estrogen at menopause and are at higher risk of certain chronic diseases, such as heart disease and osteoporosis.

***Nutritional status***

Nutritional status can definitely affect the frequency with which certain diseases occur. As the body's nutrients are depleted, it has less energy to produce antibodies and white blood cells to fight off disease agents. One of the reasons third world countries have higher mortality rates is their people do not have balanced diets. There are also specific nutritional deficiencies that produce diseases. For example, lack of vitamin C results in scurvy, or lack of iron can result in iron-deficiency anemia.

***Pre-existing disease***

We have known for a long time that the existence of one disease tends to pave the way for another illness. For example, older people dying of a chronic, noninfectious disease will frequently develop bacterial bronchopneumonia. Diabetics are susceptible to many bacterial infections, and otherwise "mild" respiratory viral infections may pave the way for a severe bacterial disease.

***Stress***

Stress is another factor that influences disease occurrence by not allowing the body's defense system to function at its fullest. We all have been told by our mothers not to get wet and chilled or we will catch a cold. Chilling is a stress on the body that weakens our defense system, allowing a cold virus opportunity to invade the body.

***Human behavior and disease***

Human behavior, including individual practices and the customs of groups, has a tremendous impact on exposure to disease agents and the manner in which agents may be transmitted. Behavioral factors and environmental influences are often hard to distinguish since they tend to influence each other. Let's examine some of the ways that human behavior can affect disease transmission.

***Diet***

The diet and food preparation practices of a population often influence the health and disease patterns within the community. For example, in some oriental countries raw fish are an important part of the diet; as a result, certain diseases such as anisakiasis and *Vibrio* infections are more common. In communities where pork is eaten, individuals may be at risk of trichinosis infection if the pork is undercooked; in communities where pork is not eaten, the risk of trichinosis is less.

There are other examples. In the past, raw milk was sold in almost every state in the United States, and was the source of outbreaks of various diseases including Q-fever, salmonellosis, and brucellosis. Pasteurization eliminated virtually all transmission of these diseases by milk. However, recently with the emphasis on natural foods, some states have allowed the sale of raw milk and, we are seeing a resurgence of these milkborne diseases.

***Disposal of human wastes***

Proper human waste disposal is important in preventing disease transmission. Improper disposal of waste, frequently occurring in underdeveloped and poorly educated countries, attracts flies that spread enteric infectious agents. In addition, when drinking water is contaminated by human waste, the result is diseases such as hepatitis A, typhoid, and giardiasis.

In some areas of the world, human feces (night soil) are used for fertilizer. This practice directly contaminates food crops that are consumed raw, such as lettuce, potatoes, and tomatoes. This practice allows the transmission of such diseases as typhoid, dysentery, amebiasis, and hepatitis A. Clams, oysters, and other shellfish may become contaminated if grown in sewage-polluted water. In the past, major outbreaks of hepatitis have been directly traced to sewage-contaminated shellfish.

***Personal hygiene***

Personal hygiene is one of the most important factors in the control of communicable disease. For example, an individual's hands are frequently contaminated during the day. If that person is a foodhandler, the result can be a foodborne outbreak from salmonella or staphylococcus.

In a childcare employee, contaminated hands could result in the spread of hepatitis A or shigella. Good handwashing eliminates these problems. Some people may not practice good personal hygiene. In some situations, individuals may not be able to practice good hygiene because of their circumstances. Soap and water may not be available. For example, in World War II some troops were unable to bathe routinely; this led to lice infestations. Since lice transmit diseases such as typhus, the troops' clothing had to be sprayed regularly with DDT to kill the lice.

#### ***Personal contact***

Personal contact includes handshaking, kissing, and sexual intercourse. Kissing can spread infectious mononucleosis and cold sores (herpes virus). Intercourse and related activities can spread crab lice, herpes virus, gonorrhea, etc. Childcare centers are a good environment for the transmission of hepatitis A, pinworms, and numerous respiratory diseases. Sanitary surveys and education of employees at childcare centers are extremely important in preventing these diseases.

#### ***Household hygiene***

Family health depends on the degree of sanitation and hygiene within the household. In certain cultures, families sleep in a single bed; therefore, contact agents and body lice can be spread as a result. The contact with pets or other animals present in the home is also important. Measures should be taken to protect against disease carriers such as flies, mosquitoes, and rodents, and to ensure good sanitation in the home and in family food handling.

#### ***Occupation/recreation***

The risk of acquiring certain diseases can be directly related to the occupation or recreational activities of the individual. Workers may be exposed to many toxic agents (e.g., lead, mercury, asbestos, and radioactive materials) in their jobs. These toxic agents may have an adverse effect on the body. Construction workers, farmers, and other outdoor workers have an increased risk of developing skin cancer as a result of prolonged exposure to the sun. Others may be exposed to zoonotic diseases from contact with animals or arthropod vectors. Recreation in itself is good, but some of our recreational habits increase the chance of contracting a disease. Recreation activities may cause an increase in accidents as well as expose us to unfriendly aspects of nature (poison ivy, oak, etc.) and certain disease vectors. Likewise, travel may take us to foreign areas where a wide variety of diseases may be endemic.

#### ***Other behaviors***

Certain individual behaviors within a society, such as over indulgence in and addiction to alcohol, tobacco, and drugs, increases the chances of getting certain diseases, such as lung cancer, and makes the individual more susceptible to other infections. For example, drug users are at greater risk of acquiring the AIDS virus or hepatitis B when they use contaminated needles.

### **204. Environmental factors**

The environment of the host and agent can have a dramatic impact on the occurrence of disease. When considering environmental effects, it is useful to think in terms of physical, biological, and social environments.

#### **Physical environment**

When talking about the physical environment, we are referring to two related factors, climate and geography.

***Climate***

The climate of an area is a key factor in the transmission of certain diseases. Respiratory diseases occur more frequently in colder months. During this time, people are generally crowded indoors, making person-to-person transmission of respiratory viruses easier. Also, the body's resistance may be lower due to the stress of colder temperatures. Enteric infections tend to increase in the summer months. Warmer temperatures bring more picnics and also a greater chance for food spoilage and growth of food pathogens.

Hayfever sufferers know the effects of climate on their condition, since the amount of plant pollen in the air is determined in most cases by the climate. Climate also can affect the survival of disease agents. Humidity, radiation from the sun, and temperature are very important in the survival of many disease agents; however, the physical effect of too much heat, radiation, or excessive drying is deadly to many disease agents, such as bacteria. Temperature and humidity are extremely important in the development of intestinal parasites. For example, roundworm eggs are very dependent on adequate humidity and warm temperature in the soil to become infective.

***Geography***

The occurrence of disease is also determined by the geography of an area. You can read in the Centers for Disease Control (CDC) morbidity and mortality reports how certain diseases seem to be restricted to certain areas. In part, diseases may be confined to areas where the reservoir or vector for the disease agent can survive. Distance and such geographic features, such as mountains and rivers, act as natural barriers or as aids to disease spread. Lastly, of course, geography also influences climate.

**Biological environment**

The biological environment includes all living things. Adequate nutrition provided by this environment helps our body resist many disease agents. Some plants are harmful. These include poison ivy, toxic mushrooms, and even the pollen-producing plants that make the lives of hayfever sufferers miserable. On the other hand, some plants are the source of medicines. Quinine, used to treat malaria, comes from tree bark. As you can see, plant and animal life can have both deleterious and beneficial effects. The biological environment can affect us and the spread of disease by providing homes and food for vectors and reservoirs of disease.

**Social environment**

The social environment includes many factors that are important in the occurrence of disease. These factors include the economic development or wealth of the society, culture and customs, level of education, availability of public health services, and rural versus urban community. For example, chronic diseases such as obesity and heart disease occur more frequently in industrialized nations than in less developed countries. Infectious diseases such as malaria, tuberculosis, and diarrheal diseases prevail in poorer, less developed nations. Eating raw or undercooked fish, a social or ethnic custom, increases exposure to seafood parasites. Differences in exposure to disease agents can be related to urban versus rural lifestyles. Think of the different styles of living (occupations, recreations, methods of waste disposal, etc.) and the plants and animals (sources of infection) found in each area. Tuberculosis and typhus have been historically associated with crowded industrial centers. On the other hand, certain zoonotic diseases such as leptospirosis are more commonly found in rural agricultural areas.

### **Self-Test Questions**

**After you complete these questions, you may check your answers at the end of the unit.**

#### **203. Host factors**

1. How do the skin and mucous membranes protect the body?
2. What are two protective structures the body has in addition to the skin and mucous membranes?
3. How is the abdominal cavity designed to protect the vital organs?
4. How does the respiratory tract protect itself?
5. By what functional ways does the gastrointestinal tract protect the body?
6. How does the body defend itself against living pathogens?
7. How does the age of a population affect the occurrence of disease?
8. What are the three gender factors affecting the distribution of disease?
9. What effect does an inadequate intake of nutrients have on the body?
10. What effect does stress have on host defenses?
11. What are seven human behaviors that affect disease transmission?

**204. Environmental factors**

1. What are the two *physical* environmental factors in the transmission of disease?
2. What are two geographical *features* that can act as barriers or aids to the spread of disease?
3. What are five factors included in the social environment that affect the occurrence of disease?

**1-3. Biostatistics**

Would you be interested if you were told that you only had a 10 percent chance of passing this course? Would you be interested if you were told that chances are one in three you will get a foodborne illness while stationed at your base? Whether you realize it or not, statistics such as these play a large part in your life—especially in your work.

You have already used statistics in some of your food inspection activities. Remember MIL-STD 105E? How do you suppose the accept and reject numbers came about? Magic? How about the table of random numbers? In your food inspection use of statistics, you learned that if you take a random sample of a given number of units, that sample will be representative of the entire lot within a certain percentage of accuracy. Then based on the statistical findings (i.e., the number of defects), you know you should either accept or reject the lot.

Statistics are used in all areas of our lives. The Consumer Price Index (CPI), percent chance of rain, and advertising (e.g., the number of dentists who recommend their patients chew sugarless gum to reduce cavities) are only three examples using statistics. As a public health journeyman, you'll use statistics to help analyze disease incidence, to predict future disease trends, and to summarize data.

**205. Measurements of central tendency**

Statistics are numeric facts or data that have been assembled, classified, and tabulated to present significant information about a given subject. For example, biostatistics are statistics concerning life.

There are several ways these facts may be assembled, classified, and tabulated. One of the ways to present data is through measurements of central tendency. The measurement of central tendency used to present Public Health data is the one most accurate methods of portraying a situation.

**NOTE:** Statistics can be misused in many ways, and you must ensure the message you convey with your statistical data is a correct one.

**Mean**

The number most commonly used as a measurement of *central tendency* is the mean. The mean for a sample is the sum of all the observations divided by the number of observations.

*Example:*

You are asked to give the mean age of children exposed to *Haemophilus influenza B* meningitis at the base child development center. At the end of the month there were four reported cases: two of the children were 1 year old, one was 2, one was 8.

Month's data: 1, 2, 8, 1.

Step 1 - Add all the values of the data:  $1 + 2 + 8 + 1 = 12$

Step 2 - Count the number of items: 4

Step 3 - Divide the sum of the items by the number of items:  $12 \div 4 = 3$

Solution: The mean age is 3 years old.

### Mode

Another number used to describe the center of a distribution is the mode. The mode is the number *occurring most often* in a group or set of numbers:

*Examples:*

Problem #1: During a foodborne illness outbreak investigation, the following patient ages were recorded in the emergency room log: 6, 9, 12, 15, 12, 92, 34. What is the mode for this illness?

Solution: The mode is 12 because there are two twelve-year-olds and only one of each of the other ages.

Problem #2: During a second foodborne illness outbreak investigation, the following patient ages were recorded in the emergency room log: 2, 4, 6, 8, 2, 6, 22. What is the mode for this illness?

Solution: This set of data has two modes and is called "bimodal." The modes are 2 and 6.

Problem #3: During a third foodborne illness outbreak investigation, the following patient ages were recorded in the emergency room log: 4, 9, 16, 12, 13, 7, 13. What is the mode for this outbreak?

Solution: The mode is 13.

### Median

A final measurement of central tendency is the median. To find the median of a group of observations or data, first arrange the data from the smallest number to the largest number. This ordered arrangement is called an "array." When there is an odd number of observations, the median is the *middle number* in the array. On the other hand, when the number of observations is even, the median is equal to the mean of the two middle numbers in the array.

*Examples:*

Problem #1: During a foodborne illness outbreak investigation, the following patient ages were recorded in the emergency room log (an even number of observations): 17, 3, 9, 6, 2, 11. What is the median age for this illness?

Solution:

Step 1 - Arrange the data from the smallest to the largest: 2, 3, 6, 9, 11, 17.

Step 2 - Count the number of items: six.

Step 3 - Choose the two middle values: third and fourth items (6, 9).

Step 4 - Find the mean of the two middle values ( $6 + 9 = 15$  and  $15 \div 2 = 7.5$ ).

Step 5 - The median age is 7.5.

**Problem #2:** During a foodborne illness outbreak investigation, the following number of cases were recorded in the emergency room log for five consecutive weeks (an odd number of observations): 108, 110, 104, 103, 100. What is the median for the weekly occurrence of this illness?

Solution:

Step 1 - Arrange data from smallest to largest: 100, 103, 104, 108, 110.

Step 2 - Count the number of items: five.

Step 3 - Choose the middle value: the third item.

Step 4 - The median is 104 cases per week.

### Summary

Remember, if there is an odd number of items in an array of data or set of numbers, there will be a middle number. If there is an even number of items, you must find the mean of two middle numbers to make a middle value. Don't forget, the first thing you must do is arrange the data from smallest to largest number. For populations that are approximately symmetric, the median and mean are very close together, so that it makes little difference whether you use the mean or median as the measure of central tendency. If the distribution of the population is highly skewed (i.e., some of the data are vastly different from the rest), the mean and median may be quite different. For example, examine the mean and median of this data: 4, 5, 4, 6, 7, 3, 4, 5, 100, 90.

### 206. Noneffectiveness rate, incidence rate, and attack rate

In Public Health, we use rates to help us describe disease events. Rates not only allow us to monitor disease events, such as outbreaks of influenza, but also to predict future disease trends and their possible impact on the Air Force mission.

#### Rates

Rates are some of the most important statistical tools used by Public Health. They are more than just numbers; rates measure the probability of occurrence of some particular event. They give meaningful statistics, even when the base population varies.

$$\text{Rate} = \frac{X}{Y} \times K$$

X = number of times an event has occurred during a specific interval of time.

Y = number of persons exposed to the risk of the event during the interval.

K = some power of 10 (10; 100; 1,000; 10,000; 100,000; etc.) depending upon the relative magnitude of X and Y. The selection of a value for K is usually made so that the "Rate" is a whole number (i.e., the "Rate" has at least one digit to the left of the decimal). For example you would want the rate to be 4.2 per 100, not 0.42 per 1000.

Some of the rates commonly used in monitoring disease are the noneffectiveness rate (NER), incidence rate (IR), and attack rate (AR).

#### ***Noneffectiveness rate (NER)***

Noneffectiveness is the temporary loss of manpower from duty. The NER is a measure of noneffectiveness due to illness or injury. It is a daily rate that indicates the number of people not physically or mentally fit for duty. Specifically, the NER represents the number of active duty individuals sick in the medical treatment facility or in quarters per 1,000 strength for the day on which it is calculated; or it may be calculated over a number of days to determine the average daily noneffectiveness rate.

*Formula*

$$\text{NER per 1000 per day} = \frac{\text{Total man - days lost in period} \times 1000}{\text{Average strength} \times \text{number of days in period}}$$

*Work-days lost*

A work-day lost is the same as a patient-day in the hospital. The total work-days lost may be obtained from the weekly statistical report, or it may be developed by totaling the number of people sick in the hospital and in quarters each day for the period under consideration. For example, one person in the hospital for one day represents one man-day lost; two people sick in quarters and two people sick in the hospital for two days is eight man-days lost. Days lost following transfer to another medical facility and days lost on convalescent leave should also be included.

**NOTE:** Only man-days lost due to active duty military being hospitalized or put on quarters are used to calculate the NER.

*Average strength*

Average strength refers to the average active duty military strength during the time under consideration. The average strength figure may be obtained from Patient Affairs or from the manpower section at the military personnel flight (MPF).

*Example 1*

Substitute the following values in the formula and calculate the NER.

Number of active duty military hospitalized or on quarters: 21

Population: 840 average strength

Period of time: 1 day

$$\text{Noneffectiveness rate per 1000 per day} = \frac{21 \times 1000}{840 \times 1} = \frac{21000}{840} = 25$$

*Example 2*

Number of active duty military hospitalized or on quarters:

1st day: 8

2nd day: 10

3rd day: 7

4th day: 5

5th day: 5

6th day: 7

7th day: 10

Total man-days lost in 7 days: 52

Population: 1600 average strength

Period of time: 7 days

$$\text{Noneffectiveness rate per 1000 per day} = \frac{52 \times 1000}{7 \times 1600} = \frac{52000}{11200} = 4.6$$

***Incidence rate (IR)***

The incidence rate is a measure indicating the frequency of new cases of a particular disease, or group of diseases, occurring in a population during a given period of time.

***The probability***

Incidence measure the probability or likelihood that healthy people will develop a given disease in a given period of time. More simply stated, incidence is the number of *new* cases of a disease in a specific population over a period time. Incidence is not the same as *prevalence*. Prevalence is the number of disease cases, old and new, occurring at a point of time.

Prevalence rates are frequently used to measure the occurrence of chronic disease. Incidence rates are a direct measure of the risk of disease and you can use incidence to examine the risk factors and the magnitude of the disease in a population.

***The formula***

$$\text{Incidence of disease X} = \frac{\text{Number of new cases occurring in a given period} \times K}{\text{Population at risk in a given period}}$$

***The denominator***

One important point about calculating incidence rates is determining the denominator for the formula (the population at risk in a given period). In our communicable disease programs, we usually use the active duty population as the population at risk. If you are concerned about a disease outbreak at the child development center, however, your population at risk could include only those children who attend the center, not the active duty population.

***The accurate estimate***

The population at risk must be defined as accurately as possible to ensure you get a true estimate of disease risk. For example, in an outbreak of hepatitis A virus (HAV), Base A has 50 cases and Base B also has 50 cases. Both bases seem to be equally affected until you look at the population at risk. Base A has 50 cases in a population of 1,500 people, while Base B has 50 cases in a population of 7,000 people. What are the incidence rates for Bases A and B? Which has the more serious outbreak?

$$\text{IR HAV Base A per 1000 persons} = \frac{50 \times 1000}{1500} = 33.3$$

$$\text{IR HAV Base B per 1000 persons} = \frac{50 \times 1000}{7000} = 7.14$$

Base A has the higher incidence of HAV infection; therefore, you could say personnel assigned to Base A have a higher risk of HAV infection. Note that in the example above, we used K=1000 so that the rate would be a whole number.

**NOTE:** You may use any power of 10 for the K value, but you must make clear which value is being used.

***Example***

Calculate the incidence rate of influenza from 1 January to 31 March per 1,000 active duty personnel:

Number of cases: Jan = 20, Feb = 35, Mar = 15

Active duty population: 7,500

$$\text{Incidence rate for influenza per 1000 Jan through Mar} = \frac{(20 + 35 + 15) \times 1000}{7500} = 9.33$$

***Attack rate (AR)***

An attack rate is a special type of incidence rate used in outbreaks. Attack rates are applied to narrowly defined populations observed for limited periods of time, such as foodborne illness outbreaks or epidemics. This rate is usually expressed as a percent; therefore, the value of K is would be equal to 100.

***The use of AR***

We use attack rates in the investigation of foodborne illness outbreaks to determine the food (or foods) most likely responsible for the outbreak.

***The determination of AR***

Attack rates may be determined for the entire population at risk, or you may calculate attack rates by gender or age.

***The formula for AR***

$$\text{Attack rate of disease X} = \frac{\text{number of cases} \times 100}{\text{population at risk}}$$

***Example 1***

In an outbreak of salmonellosis, there were 37 ill persons in a group of 96 attending a picnic. What is the attack rate per 100 persons?

Number of cases: 37

Population at risk: 96

$$\text{Attack rate per 100 persons} = \frac{37 \times 100}{96} = 38.5$$

***Example 2***

In the same outbreak, there were 16 ill males out of a total of 43 males present. What is the attack rate for males per 100 persons?

Number of cases: 16

Population at risk: 43

$$\text{Attack rate per 100 persons} = \frac{16 \times 100}{43} = 37.2$$

## Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

### 205. Measurements of central tendency

1. What is a definition of the term “statistics”?
2. For the aerospace medicine report, you are asked to report the number of mosquitoes trapped and identified as medically important. Your counts of mosquitoes trapped each day for 13 days are 0, 0, 3, 6, 0, 9, 3, 6, 9, 11, 2, 0, 60. What are the mean, mode, and median number of mosquitoes trapped over these 13 days?
3. Calculate the mean, mode, and median using the data in question #2 above, except on day 13 use 600 for the daily count instead of 60.
4. Briefly describe the process for calculating the median of an array of numbers?

### 206. Noneffectiveness rate, incidence rate, and attack rate

1. With an average strength of 1,200, you lost 45 work-days during a 7-day period. What was your NER?
2. With an average strength of 2,400, you lost 38 work-days during a 30-day period. What was your NER?
3. With an average annual population of 5,200, you had 36 cases. What was your NER?
4. With an average annual population of 4,200, you had 48 cases. What was your NER?

5. With an average population of 4,200, you had 14 new cases of gonorrhea occurring within 1 month. What was your monthly IR?
6. Ninety six persons attended the base picnic—87 males and 9 females. There were 26 cases of staphylococcal food poisoning—19 males and 7 females. What was the AR?

## 1-4. Epidemiological Investigations

In Public Health programs, we use epidemiology for many purposes. One is to determine the significance and impact of disease on the military mission in an effort to focus on investigative efforts and preventive measures. We also use epidemiologic studies to learn more about how a given disease progresses in patients and the effect of disease on the patients and the community. Probably the most common use of epidemiologic studies, however, is to determine the risk factors or causative agents of disease.

There are two types of epidemiologic studies or investigations, experimental and observational. It is important that you have a working knowledge of these two types of studies — their advantages and limitations — in order to select the best method for the circumstances and disease.

### 207. Study methods

In order to determine the reason for disease presence, whether endemic or epidemic, you can use various study methods. These methods can be broadly classified as either experimental or observational. The experimental method is more accurate than the observational method, but the latter method is the one most often used.

#### Experimental method

Ethics do not permit indiscriminate disease experimentation on human populations, so the experimental method is usually performed on small groups of individuals or animals. An example of the experimental method would be gathering two groups of equally susceptible people, matched by age, gender, and other factors; administering a vaccine, special diet, or some other factor to one group; and withholding the factor from the other. By observing the results, a determination is made of the effect, or lack of effect, of the added factor. An experiment is not valid without a control group from which the factor is withheld.

Suppose you take 50 basic military trainees and divide them into two groups of 25 each. The first group is the control group. This group is allowed to eat only three meals a day in the dining hall. The second group, the experimental group, is allowed to consume liquids only, such as fruit juices, milk, and water. The experiment lasts for the 6 weeks of basic training. All 50 students will be weighed daily. Do you think the average weight of the experimental group goes up or down in comparison with the control group? This is an example of using the experimental method.

#### Observational method

By contrast, the observational method involves studying different groups under natural conditions. With this method, nature selects the groups — individuals who are exposed or and individuals who are not exposed to a particular factor. You only observe, record, and state the result. The observational method, unlike the experimental method, can be carried out more easily on large numbers of individuals or communities. The two types of observation are controlled and uncontrolled.

***Controlled observation***

The controlled observation uses two similar populations or communities, except for the factor under observation. A case-control is one example of this type of observation. Using case controlled observation, a control group (a group of individuals not having the disease) is chosen to match the group that is under observation in such characteristics as age, gender, and ethnic group. The “control” group is used as a standard. The actions or results of the group that is under observation are compared to those of the control group.

Here is an example of a case-control study: Select ten people who have a diagnosis of lung cancer for observation. Then select ten people who do not have cancer, matching age, gender, ethnic group, occupation, etc., with the group to be observed. The lung cancer patients are your case group and the healthy people are your control group. Next, you look for differences between the groups such as diet, number of cigarettes smoked per day, previous illnesses, etc.

***Uncontrolled observation***

Uncontrolled observation include studies during which there are no explicit controls (i.e., same gender, ethnic group, age), but a judgment is made as to whether or not the cases are different from the rest of the population. This is the method usually used for such things as tracing the source of a food poisoning outbreak or serious epidemics, or examining sexually transmitted disease incidence and prevalence. Here is an example of an uncontrolled observation study: Suppose that 300 people ate at a church picnic, and 75 of those people developed a foodborne illness. The 225 are not matched for age, gender, ethnic group, or similar characteristics; however, you would compare what foods the 75 ate with the foods the other 225 ate.

***Variations in study design***

In addition to different study methods, there are also different designs for epidemiologic studies. These different study designs are often called prospective, retrospective, and cross-sectional.

***Prospective (looking forward)***

This is a plan of study in which a group under observation is divided into two groups, one having a factor believed to contribute to a disease and the other without the factor. The groups are then observed over time to identify which individuals develop the condition or disease under study. This type of study is usually spread over an extended period of months or years, with the chance none of the chosen individuals will develop the condition under study. This type of study is appropriate for determining the attack rate per unit of time and per number of people for a given disease.

***Retrospective (looking back)***

This is, for all practical purposes, the same as the case-control method previously described. In this design, you study persons who already have the disease; you also study people who are free from the disease. Then you compare them and try to identify a factor or factors that are more common to people who became cases than to people who became controls. Advantages of this design are ability to study rare diseases, ability to draw immediate conclusions, and less chance of the subjects’ leaving the jurisdiction of the observer.

***Cross-sectional survey***

This is simply observing, questioning, and studying a population at one point in time in order to detect cases of a disease. The use of laboratory screening procedures or complete diagnostic evaluation may be helpful. Simple items of information, such as age, gender, ethnic group, and occupation, are gathered on all persons, including those who do not have the disease. This way, the prevalence of disease can be determined, and any correlation between factors such as age, gender, ethnic group, and frequency of disease may be identified.

## 208. Procedures for conducting epidemiological investigations

An *outbreak* occurs when the frequency of a disease in a given population during a given time interval is clearly in excess of what is expected or normal. This may include infectious and noninfectious conditions, such as an occupational illness. In Public Health, we monitor and report the occurrence of certain diseases and use rates such as incidence or attack rates to estimate the risk of diseases. We use routine surveillance to identify the normal occurrence or frequency of disease in our base population. By knowing what is normal, we can identify and investigate unusual occurrences or disease outbreaks.

The term outbreak is broad and there is no general rule about the number of cases that must occur before an event is considered an outbreak. The purposes of outbreak investigation are to control the outbreak if it is still occurring; identify the source, mode of transmission, and population at risk (chain of infection); and identify measures to prevent future occurrences.

There is a logical sequence to outbreak investigation involving a series of steps. However, the steps are not an exact sequence in which you conduct an investigation; in practice, several steps may be done simultaneously. In this lesson you will learn what these steps are and how to follow them during outbreak investigations.

### Prepare for field work (Step 1)

As with any type of procedure you complete either on or off the job, preparation is the first step and should be considered carefully. With regard to the outbreak investigation itself, you'll need to have the scientific knowledge to conduct it, or find a way to get it. Use all the resources available to you, including your supervisory chain and the reference library maintained in the office. You should know where your laboratory consultation support is coming from and also be sure that you have the necessary supplies to conduct the investigation. From an administrative stand point, you will need to review applicable operating instructions and local directives. Finally, know your role in the investigation, especially if you're working off-base.

### Establish existence of an outbreak (Step 2)

To decide whether an outbreak exists, compare the current incidence and the usual or expected incidence. Local disease surveillance (base, community, or state) gives you an idea of disease occurrence for your population, during a given time or season. If the current incidence is significantly greater than the usual, then an epidemic or outbreak exists. For example, if the incidence of chickenpox in your base population has been highest in January and February among children attending the base child development center, you would be alarmed to see a significant increase in the summer months.

### Early detection

What constitutes a significant increase is sometimes a problem to determine. Large common-course outbreaks are usually no problem to recognize; however, early detection of propagated source or vectorborne disease outbreaks is more difficult. In some instances, the Air Force defines a disease outbreak. For example, a single case of botulism constitutes an "outbreak" and should be investigated.

### Outbreak

Once you think you have an outbreak, be on the lookout for other cases—cases not reported or newly developing cases. The emergency room logbook or reports, laboratory logs, clinic reports, and family or friends of known cases are very good sources for *case-finding*. Finding these additional cases can help confirm the existence of an outbreak.

**Take steps to establish or verify the diagnosis (Step 3)**

Always consider whether initial reports or diagnoses are correct. The initial diagnosis may be wrong, for example leptospirosis reported as hepatitis A. As you have seen, different diseases have different reservoirs, modes of transmission, etc. Knowing what disease you are looking at is important so you know where to concentrate your investigative efforts. In your investigation, you will be comparing cases and non-cases. Background illness exists, but you do not want this to confuse your findings. Being able to confirm the diagnosis in each of your cases helps separate cases from non-cases.

***The diagnosis***

The diagnosis may be confirmed or verified by laboratory tests, if they are available. However, it usually takes some time to verify or confirm the diagnosis. For example, culture results often take days to come back from the lab. If you cannot confirm the diagnosis right away, you still need to separate cases from non-cases.

**Define and identify cases (Step 4)**

A case definition can be used until the diagnosis can be confirmed, that is, if it can be confirmed. A case definition is a set of specific criteria. If a person meets the criteria, the person is a case. If not, the person is a non-case. Acquired immunodeficiency syndrome (AIDS) is a good example of using a case definition. In the early 1980s, the causative agent for AIDS had not been identified, so patients were counted as cases if they had specific symptoms and no other disease affecting the immune system. After the human immunodeficiency virus (HIV) was identified in 1985, the diagnosis of AIDS by symptoms could be verified by an antibody test for HIV.

**Perform descriptive epidemiology (Step 5)**

Use time, place, and people to characterize data and identify patterns. This helps develop a hypothesis or explanation as to why the outbreak occurred.

***Time***

You need to describe the exact period of the outbreak in hours, days, or weeks, depending upon the agent. Then you construct a graph of cases plotted according to the time of the onset. This graph is called an “epidemic curve.” The two purposes for constructing the epidemic curve are (1) to determine if the source is most likely common, propagated (person to person), or both and (2) to identify the probable time of exposure to the source of infection.

***Place***

To characterize the outbreak by place, make a spot map of the base. You can create a spot map by putting a pin, dot, or other mark at the defined place where a case occurs. You may define *place* as the residence; work area; hospital floor, ward, or service; school; or other. After the spot map is created, look for clustering. When clusters occur, determine an association with possible sources of infection, such as water, milk or food supplies, or agricultural or industrial exposures. Don’t forget to consider the population at risk in a particular place. There may be differences in the size of the populations. Calculate incidence rates to eliminate the effects of population differences.

***People***

People are described in terms of the characteristics such as age, ethnic group, immune status, or marital status. You may also characterize people in terms of lifestyle and behavior (e.g., work, recreation, and religious customs). Such characteristics and activities are important since they determine who is at greatest risk of getting specific infections or diseases. You can describe an outbreak in terms of person by using characteristic-specific rates such as age-specific or gender-specific attack rates. Once you have determined attack rates according to characteristics, look for significant differences among persons with and without one or more specified characteristics.

**Develop a hypothesis (Step 6)**

This step involves developing a hypothesis or explanation for the outbreak. A hypothesis is really a *best guess*. Typically it includes the suspected causative agent, source of infection, period of exposure to the source, means of transmission, and the population at risk of infection (now or in the future). Consider the usual reservoirs and the known risk factors of your population to figure out the exposures that may have caused the disease. Look at person, place, and time for clues. This requires familiarity with the disease. Once you generate a hypothesis, you usually must gather additional information in order to confirm or reject it. Your hypothesis should be testable. If you are having trouble developing a hypothesis, review again the information you gathered from the people who were ill and those who were not ill. It may also be helpful to talk with these people again, particularly the outliers. Remember that the outliers may have information that will provide clues as to the cause of the outbreak.

**Evaluate hypothesis (Step 7)**

There are two ways to evaluate your hypothesis: (1) using descriptive epidemiology, which uses person, place, and time, or (2) using analytic epidemiology, which uses statistics and a comparison group. In either case, compare your hypothesis with established facts to test your own hypothesis.

**Reconsider and refine your hypothesis (Step 8)**

As necessary, reconsider/refine hypotheses and execute additional epidemiological studies. This often means getting assistance from laboratories outside of your installation, and it may mean considering additional environmental concerns as well.

**Implement prevention and control measures (Step 9)**

Think about the components of your hypothesis — the agent, source, means of transmission, and susceptible population. These components are the same as those in the chain of infection discussed earlier. By determining the chain of infection in the outbreak, you can implement measures against specific links to either control the present outbreak or prevent future ones.

When the source and means of transmission have been confirmed, you can identify persons who are at increased risk of exposure. Exactly who is at increased risk depends on the agent, the nature of the source, how the agent is transmitted, and the characteristics of the susceptible individuals that increase the likelihood of exposure. For example, children under age five are the most susceptible persons for *Haemophilus influenza* B (HIB) meningitis. In an outbreak of HIB meningitis at the day care center, the population at increased risk of infection (high risk group) is children under five. You would not include adult care givers in the high risk group. The identification of populations at increased risk of infection or disease is important when implementing prevention or control measures, the sixth step.

**Communicate your findings (Step 10)**

This important step is frequently overlooked. Remember, part of the purpose of an investigation is to prevent future outbreaks. Be sure to include in your report recommendations for prevention of similar episodes in the future. A report helps you share with others what you have learned and, thus, enhances prevention. A report improves the likelihood experiences gained and discoveries made are put to the best possible use. The Air Force requires reports in certain cases, such as foodborne illness outbreak investigations, and you will see more about this in the next section.

## Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

### 207. Study methods

1. Administering a vaccine or special duty to one group and withholding it from another group to determine its effect is an example of what kind of study method?
2. When nature provides the data for your investigation and you only observe, record, and state the result, what method are you using?
3. Generally, which method of study is used to trace the source of food poisoning outbreaks?
4. Looking back in time to compare individuals with a disease to individuals without the disease to identify factors more common to the cases is what type of study design?
5. Getting information about disease and other factors in a population at one point in time is what method of study?

### 208. Procedures for conducting epidemiological investigations

1. What are five purposes for an outbreak investigation?
2. What are steps two and three of an outbreak investigation?
3. What is an epidemic curve?
4. What are the two reasons for constructing an epidemic curve?
5. What is included in the epidemiological hypothesis?

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## Answers to Self-Test Questions

### 201

1. A living person or animal that is harboring a disease agent.
2. A person or animal that harbors a disease agent but has no clinical signs of the disease.
3. Organisms that live on or in the body of a host and can produce disease or illness.
4. The ability of the agent to invade and multiply, or to produce infection in the host.
5. Ability of an agent to produce clinical disease in a host.
6. Agent unable to penetrate host's body or unable to stay in host's body; agent may enter host's body but not cause signs and symptoms; and agent may invade host's body, multiply, and cause signs and symptoms of disease.
7. Ingestion, inhalation, and penetration.

### 202

1. Source or reservoir, mode of transmission, and a susceptible person or host.
2. Person, animal, inanimate object, or substance.
3. Direct contact, contact with droplets, contact with contaminated object or material, contact with infected insect.
4. Breaking the chain of infection at the source includes diagnosis, treatment, isolation, destroying the source, and education. Breaking the chain at the means of transmission includes preventing contact with the source (direct contact transmission) or vehicle, environmental sanitation, water treatment, food hygiene, waste treatment, vector control, and education. Breaking the chain of infection at the susceptible person includes personal hygiene, immunization, prophylaxis, and education.

### 203

1. by providing a protective covering against living organisms and many chemicals.
2. Any two: hair, sweat glands, fat pads, skeleton, cilia.
3. It is well lubricated so the organs will slide out of line with direct pressure and sharp objects.
4. Initiate coughing or sneezing and cilia beating to remove harmful substances.
5. Initiate vomiting and diarrhea to move unwanted objects out of the system.
6. The pathogens are trapped in the lymphatic system, or white blood cells attack and destroy them at a site of inflammation.
7. The very young have poorly developed immune systems, while the very old have defense systems that are starting to weaken.
8. Anatomical differences, hormonal factors, and exposure potential.
9. There is less energy that can be used to produce antibodies and white blood cells.
10. It does not allow the body's defense system to work at its fullest.
11. Diet, disposal of human wastes, personal hygiene, personal contact, household hygiene, occupation, and recreation.

### 204

1. Climate and geography.
2. Mountains and rivers.
3. Economic development, culture or customs, education level, public health services availability, whether rural or urban.

**205**

1. Numeric facts or data assembled, classified, and tabulated to present significant information about a given subject.
2. Mean=8.3846, Mode=0, and Median=3.
3. Mean=49.923, Mode=0, and Median=3.
4. Arrange the data from smallest to largest. Determine if you have an odd number of samples or an even number of samples. If you have an odd number of samples, the median is the middle number; if you have an even number of samples, the median is the mean of the middle two numbers.

**206**

1.  $\frac{45 \times 1000}{1200 \times 7} = \frac{45000}{8400} = 5.357$
2.  $\frac{38 \times 1000}{2400 \times 30} = \frac{38000}{72000} = 0.52777$
3.  $\frac{36 \times 1000}{5200 \times 365} = \frac{36000}{1898000} = 0.018967$
4.  $\frac{48 \times 1000}{4200 \times 365} = \frac{48000}{1533000} = 0.031$
5.  $\frac{14 \times 1000}{4200} = \frac{14000}{4200} = 3.33$
6.  $\frac{26 \times 100}{96} = \frac{2600}{96} = 27.08$

**207**

1. Experimental method.
2. Observational method.
3. Uncontrolled observation.
4. Retrospective.
5. Cross-sectional survey.

**208**

1. Control the outbreak if it is still occurring; identify the source, mode of transmission, and population at risk; and measures to prevent future occurrences.
2. Step 2: Establish the existence of an outbreak. Step 3: Establish or verify the diagnosis.
3. A graph of cases plotted according to time of onset of illness.
4. To determine if the source is common, propagated (person-to-person), or both; and to identify the probable time of exposure.
5. Suspected causative agent, source of infection, period of exposure, means of transmission, and the population at risk.

**Do the unit review exercises before going to the next unit.**

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## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to ECI Form 34, Field Scoring Answer Sheet.

**Do not return your answer sheet to AFIADL.**

1. (201) A primary or definitive host is a host in which a disease organism
  - a. attains its maturity and goes through its sexual or reproductive stage.
  - b. becomes most easily identified by laboratory tests.
  - c. has not yet invaded an intermediate host.
  - d. enters the larval stage.
2. (201) The ability of an agent to produce clinical disease in a host is its
  - a. virulence.
  - b. infectivity.
  - c. penetrability.
  - d. pathogenicity.
3. (201) *Entamoeba* and *Giardia*, which are usually waterborne or foodborne and cause diarrhea, are examples of
  - a. parasitic protozoa.
  - b. complex bacteria.
  - c. viruses.
  - d. fungi.
4. (201) Ringworm is an example of
  - a. fungi.
  - b. metazoa.
  - c. protozoa.
  - d. rickettsia.
5. (202) Rabies is spread by
  - a. direct contact.
  - b. airborne contact.
  - c. vectorborne contact.
  - d. vehicleborne contact.
6. (202) Giving hepatitis A vaccine and malaria prophylaxis to deploying troops controls what link in the chain of infection?
  - a. Source.
  - b. Vehicle.
  - c. Susceptible person.
  - d. Means of transmission.

7. (203) Anatomical differences, hormonal factors, and exposure potential are examples of what intrinsic factor in the occurrence of disease?
  - a. Age.
  - b. Race.
  - c. Gender.
  - d. Religion.
8. (203) In countries where pork is eaten, individuals may be at risk of trichinosis infection when the pork is undercooked. This is an example what intrinsic factor in the occurrence of disease?
  - a. Diet.
  - b. Personal hygiene.
  - c. Physiological state.
  - d. Preexisting disease.
9. (203) Using night soil as a fertilizer allows the transmission of such diseases as typhoid, dysentery, amebiasis, and hepatitis. Preventing transmission of these diseases involves educating people on
  - a. proper disposal of human wastes.
  - b. good household hygiene.
  - c. good personal hygiene.
  - d. occupational hazards.
10. (204) The environmental factor that has the greatest effect on hayfever sufferers is
  - a. social.
  - b. climate.
  - c. geography.
  - d. physiological.
11. (204) What environmental factor relates to the fact that quinine, used to treat malaria, comes from tree bark?
  - a. Social.
  - b. Climate.
  - c. Biological.
  - d. Geography.
12. (204) The availability of public health services is an example of what environmental factor?
  - a. Social.
  - b. Physical.
  - c. Biological.
  - d. Geography.
13. (205) Numeric facts or data that have been assembled, classified, and tabulated to present significant information about a given subject are called
  - a. statistics.
  - b. the mode.
  - c. the mean.
  - d. the median.

14. (205) What number is most commonly used as a measurement of *central tendency*?
- Rate.
  - Mean.
  - Mode.
  - Median.
15. (205) The *mode* for the numbers 6, 18, 26, 14, 12, 19, 20, and 26 is
- 17.625.
  - 18.500.
  - 19.250.
  - 26.000.
16. (205) The *median* of the numbers 3, 3, 5, 7, 8, 9, and 12 is
- 3.00.
  - 6.71.
  - 7.00.
  - 8.21.
17. (206) The frequency of new cases of a disease, or group of diseases, that occurs in a population during a given time is the
- attack rate.
  - hospital rate.
  - incidence rate.
  - noneffectiveness rate.
18. (206) Public health workers use attack rates when investigating foodborne illness outbreaks to determine
- the time the food was consumed.
  - the gender of the average patient.
  - the food or foods most likely responsible for the outbreak.
  - the average number of items consumed by the ill population.
19. (206) If 30 out of 90 people who ate at a base picnic became ill, the attack rate per 100 persons is
- 3.33.
  - 33.30.
  - 333.00.
  - 333.30.
20. (207) A method that is used to study two similar groups by administering a vaccine, special diet, or some other factor to one group while withholding it from the other group is called
- prospective.
  - experimental.
  - retrospective.
  - observational.
21. (207) A method that is used to study different groups under natural conditions is called the
- prospective method.
  - experimental method.
  - retrospective method.
  - observational method.

22. (207) This method of study involves simply observing, questioning, and studying a population at one point in time to detect cases of a disease.
- a. Cross-sectional survey.
  - b. Observational method.
  - c. Retrospective survey.
  - d. Statistical analysis.
23. (208) In an outbreak investigation, what step do you take after confirming the existence of an outbreak?
- a. Define and identify cases.
  - b. Communicate your findings.
  - c. Establish or verify the diagnosis.
  - d. Perform descriptive epidemiology.
24. (208) In what step of an outbreak investigation do you construct an epidemic curve or graph of cases that is plotted according to time of onset?
- a. Step 2 (establish existence of an outbreak).
  - b. Step 3 (take steps to establish or verify the diagnosis).
  - c. Step 4 (define and identify cases).
  - d. Step 5 (perform descriptive epidemiology).

## Unit 2. Communicable Disease

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**I**T IS VITAL to the success and functional fulfillment of our mission that we survey, anticipate, act against, and prevent the various vectors, animals, and accompanying complications of the many diseases that threaten any active duty military population. For us, this requires knowledge in a variety of airborne/respiratory diseases, sexually transmitted diseases, and hepatitis and enteric diseases. Also, we must have knowledge of communicable disease reporting, infection control, foodborne illnesses, and the rabies control program. All of these areas are discussed in this unit.

### 2–1. Airborne/Respiratory Diseases

Respiratory or airborne diseases are the most important of the communicable diseases occurring among the active duty population because of their effect on Air Force operations and activities. Respiratory diseases are readily transmitted by casual contact, and they are difficult to control or prevent. Although vaccines have been developed for common respiratory diseases, such as mumps and rubella, others still pose a threat to the health and effectiveness of our highly mobile force. While there are many respiratory or airborne diseases, you will learn about only a few of the more common diseases in this section.

## 209. Respiratory diseases

The diseases you'll concentrate on here are those types of meningitis that are most threatening to our military community: streptococcal infections and influenza.

### Meningitis

Meningitis is simply an inflammation of the meninges (membranes covering the brain and spinal cord). Although various organisms, such as bacteria, viruses, fungi, and parasites, can cause meningitis, the viral form of meningitis is the most common.

### *Bacterial meningitis*

This is the most serious type of meningitis, and it is sometimes fatal. The three bacteria commonly responsible are *Neisseria meningitidis*, *Haemophilus influenzae*, and *Streptococcus pneumoniae*.

### *Meningococcal meningitis*

*Neisseria meningitidis* is the organism responsible for causing this type of meningitis. Many people carry the organism in their nasopharynx, but never develop the disease. These people are asymptomatic carriers and capable of transmitting the disease. This presents a problem when you're trying to determine the source of an infection or outbreak.

Bacterial meningitis spreads easily from person to person by direct contact or by droplet infection. Since the responsible bacteria are carried in the nasopharynx, all oral or nasal discharges are capable of transmitting the disease. It spreads easily among family members and in close quarters. In the past, outbreaks have occurred on military installations where large groups of people live in confined areas. Such outbreaks usually occur if the disease is present in either the base or off-base community.

Meningitis is primarily a disease of very small children, but it is common in young adults, more so in males than females. The incubation period of meningococcal meningitis varies from 2 to 10 days, with an average of 3 to 4 days.

Signs and symptoms include sudden onset of fever, headache, nausea, occasional vomiting, stiff neck, and very often a rash. Some patients progress to delirium or coma. Diagnosis is made by recovery of meningococci in the cerebrospinal fluid (CSF) or blood. With early diagnosis and antibiotic treatment, the mortality rate is less than 10 percent.

### *Haemophilus meningitis*

*Haemophilus meningitis* is caused by the organism known as *Haemophilus influenza* type B (HIB). The infection occurs most often in children between the ages of 2 months and 5 years of age. It is very unusual to see this disease in children over the age of 5. An ear infection (otitis media) or sinusitis usually precedes the infection. Signs and symptoms include a sudden onset of fever, vomiting, lethargy, and bulging fontanelle in infants or stiff neck and back in older children. It may even progress to stupor or coma. The patients are communicable as long as the organism is present. A diagnosis is made by isolating the organism from the blood or CSF. The patient is considered noncommunicable after 24 to 48 hours of antibiotic therapy. Secondary cases are problems in families and child development centers because young children are primarily affected. There is an effective vaccine available, and it should be administered before the child starts attending day care centers and family day care programs.

### *Pneumococcal meningitis*

Pneumococcal meningitis is caused by *Streptococcus pneumoniae*; it occurs mainly in infants and the elderly. Signs and symptoms include a sudden onset of chills, high fever, difficulty breathing, productive cough, and chest pain. The cough produces "rusty" or blood-tinged sputum. The diagnosis is confirmed by identifying pneumococci in the blood or respiratory secretions. There is an effective vaccine for this type of meningitis.

### ***Viral meningitis***

Viral meningitis is normally called “aseptic meningitis,” and is more common and less severe than bacterial meningitis. There are several viruses that cause the disease, but the mumps virus seems to be the most common. Other common viruses that cause the disease include herpes simplex and varicella. Viral meningitis is characterized by sudden onset of fever and headache. The mode of transmission and incubation period vary, depending on the virus responsible for the infection. The illness seldom exceeds 10 days in duration and is rarely fatal.

### **Streptococcal infections**

Streptococcal sore throat is the most common type of streptococcal infection caused by the *Streptococcus pyogenes* (group A strep) organism. Infected individuals carry the organism in the oropharynx, and transmit the droplets through kissing, touching, or sharing drinking or eating utensils. The incubation period of streptococcal sore throat is 1 to 3 days. Streptococcal infection is characterized by the sudden onset of sore throat, fever, and headache. The normal treatment for a laboratory-confirmed infection is penicillin; however, the infection usually resolves itself if left untreated. The problem with untreated streptococcal sore throat is that it could progress to rheumatic fever, kidney inflammation, or scarlet fever. Early diagnosis and treatment of the original infection can prevent such complications. Streptococcal infections occur most often in the winter when people are indoors in close contact.

### **Influenza**

Influenza is an acute febrile respiratory infection that may exhibit systemic manifestations. The agents are viruses of three distinct subtypes: A, B, and C. Each influenza virus has two identifying surface antigens (protein substances on the virus): hemagglutinins (H) and neuraminidase (N). Influenza viruses change rapidly because of changes in the H and N antigens. “Antigenic drift” refers to minor changes; and “antigenic shift” refers to major changes. The “antigenic shifts” often result in epidemics.

### ***Incubation period***

The average incubation period of influenza is 1 to 3 days. Symptoms include a sudden onset of chills, fever, headache, generalized aching, and malaise. Fever may last from 1 to 7 days, with the average lasting for 3 days. Most patients recover in a few days. The elderly and people with chronic diseases, however, are prone to complications such as pneumonia.

### ***AF concern***

If most people fully recover, why is the Air Force so concerned about influenza? Large outbreaks threaten operational readiness and severely compromise the Air Force’s ability to accomplish the mission. Therefore, the Air Force instituted Project Gargle. Because of the success of Project Gargle, the program, now called the Influenza Surveillance Program, is tri-service; and the Air Force is the lead agent. The program is administered by the Global Emerging Infections System.

### ***Influenza Surveillance Program***

The purpose of this program is to identify new strains of influenza virus. The program identifies emerging influenza strains, provides timely input to vaccine composition, and limits the impact of influenza on the Air Force mission.

The Air Force Institute for Environmental, Safety and Occupational Health Risk Analysis, Risk Analysis Directorate, Risk Assessment Division, Force Health Protection & Surveillance Branch (AFIERA/RSRH) directs the Influenza Surveillance Program. The Force Health Protection and Surveillance Branch monitors the cases of influenza that have been isolated by the Epidemiological Surveillance Division (AFIERA/SDE) from sentinel sites around the world. This information is provided on a worldwide basis; information is also provided to the Surgeon General, Department of Defense, and national and international health authorities.

**Public Health (PH) concern**

As a public health journeyman you actively support the Influenza Surveillance Program. If you're stationed at a sentinel base, you will monitor the collection of throat swabs (using virus-specific swabs) on patients who have upper respiratory infections and meet the Project Gargle case definition. If stationed at a non-sentinel base, you may submit specimens if it is deemed important. Specimens are sent to the Virology Section at AFIERA/SDE. SDE provides collection materials on request.

**210. Pulmonary tuberculosis**

Tuberculosis is a communicable disease affecting the lungs, and in some cases, other parts of the body. It's not a new disease. Hippocrates recorded the first clinical description around 400 B.C. It was not until 1882, however, that Edward Koch identified the tubercle bacillus that causes the infection in man.

**Causative agent**

*Mycobacterium tuberculosis* (*M. TB*) is the organism that causes pulmonary tuberculosis in humans. In addition to being found in the lungs, the bacillus can be found in other organs of the body, including the kidneys, spine, and lymph nodes. Tuberculosis in the lungs, however, poses the greatest threat for human to human transmission of the disease.

**Mode of transmission**

Tuberculosis is a respiratory disease transmitted by the inhalation of droplet nuclei containing live *M. TB*. Not all droplets are harmful; the droplets need to be small enough (one to five microns) to reach the alveoli of the lungs. The probability that TB will be transmitted depends on three factors:

1. the infectiousness of the person with TB,
2. the environment in which exposure occurred, and
3. the duration of exposure.

Nasal hairs and bronchial cilia act as protective devices in the respiratory tract and filter out larger particles. Evidence supports the theory that dried residues of droplet nuclei remain suspended in air for a prolonged period. Once droplet nuclei settle to the ground, they can no longer cause infection. A single exposure to tuberculosis is not likely to result in infection. It takes repeated, prolonged exposures to develop infection, as those occurring in close quarters, such as homes, dormitories, nursing homes, classrooms, or offices. Outdoor exposures rarely lead to infection.

**Incubation period**

The incubation period from infection to an obvious lesion or tuberculin reaction is about 4 to 12 weeks.

**Pathogenesis**

Tuberculosis is a disease of highly variable character, which consists of three stages: infection, dormant, and active. Initial infection usually goes unnoticed. If a susceptible person inhales tubercle droplets, and the droplets reach the alveoli of the lungs, tuberculin sensitivity usually appears within a few weeks.

**Infection stage**

The disease spreads when a susceptible person inhales the droplets containing the tubercle bacilli, and they reach the alveoli of the lungs. This is the beginning of the infection stage. The bacilli multiply slowly, with some remaining in the lungs, while others travel to the lymph nodes and the blood stream. Usually the white blood cells attack and destroy the bacilli in the blood stream. Active disease, therefore, is usually confined to the lungs since bacilli in the lungs are not destroyed. Lesions caused by this primary infection usually heal and calcify, and the infection proceeds to the dormant stage.

***Dormant stage***

Ninety percent of infected individuals never progress beyond the dormant stage. During this stage, bacilli encapsulate and remain in the alveoli of the lung until conditions favor further growth and progression to the active stage, usually later in life or during a period of altered immunity. Conditions that favor growth include diabetes, alcoholism, silicosis, immunosuppression due to cancer therapy, and acquired immunodeficiency syndrome (AIDS).

***Active stage***

The active stage follows either the infection stage or the dormant stage. If lesions do not heal properly during the infection stage, bacilli “spill out” and become engulfed by macrophages. During this process, macrophages and other tissues form a soft, caseous (cottage cheese-like) mass. This mass slowly disintegrates and discharges bacilli in droplet form. The infected person then transmits the disease while coughing.

**Signs and symptoms**

Most patients have no symptoms during the infection stage, and do not seek medical attention. Patients may experience a slight fever or a feeling of discomfort shortly after infection, but these symptoms disappear as the infection enters the dormant stage. The onset of *active* tuberculosis is insidious, with vague symptoms, such as fatigue, weight loss, fever, chills, night sweats, loss of appetite, and a persistent cough, that go unnoticed. Most patients do not seek medical attention until they develop a persistent productive cough, cough up blood, or experience chest pains.

**Diagnostic techniques**

Tuberculosis is a difficult disease to diagnose. Early symptoms are vague and mimic other diseases. Patients often blame their symptoms on stress or overwork, and do not seek medical treatment until symptoms become severe. When considering a diagnosis of pulmonary tuberculosis, a provider needs to gather a complete medical history, perform a physical examination, administer a tuberculosis skin test (TST), get a chest X-ray, and conduct a bacteriologic exam (smear/culture).

***Skin tests***

TSTs are used (1) to identify infected persons at high risk of developing TB disease who would benefit from preventive therapy and (2) to identify persons with TB disease who need treatment. Refer to AFI 48-115, *Tuberculosis Detection and Control Program*, to determine when to test and who to test.

The Air Force uses the Mantoux test to confirm tuberculosis infection. It is the most effective and accurate test procedure available, and it is the standard. It uses a solution of purified protein derivative (PPD) tuberculin stabilized with a biologic assay solution to five tuberculin units (TU). The solution is then injected intracutaneously (just beneath the surface of the skin). Positive reactions (delayed tuberculin hypersensitivity) occur within 48 to 72 hours after injection. Although redness may occur, the area of induration is the basis for measurement.

***Bacille Calmette-Guerin vaccinations (BCG)***

Two French scientists prepared the vaccine from a strain of *Mycobacterium bovis*. Albert Calmette and Camille Guérin weakened the virulence of the original organisms over a period of many years. In 1921, the first live vaccine against tuberculosis, bacille Calmette-Guerin (BCG), was tested in humans. Today's vaccines are made from the same strains.

***Purpose***

The purpose of the BCG vaccination is to prevent the recipient from experiencing a natural primary infection by artificially inducing a harmless primary infection. BCG was designed to enhance a person's resistance to a subsequent more virulent infection. Its ability to protect vaccine recipients varies with effectiveness rates ranging from 0 to 70 percent. Experts agree that the vaccine is most

valuable in areas with high incidence of tuberculosis, such as developing countries. In these areas BCG may not prevent infection, but it may prevent severe cases and reduce complications. The vaccine's relative ineffectiveness is the reason it is not used in the United States.

#### *Effect on skin testing*

Most BCG vaccines have a positive TST after the vaccination. However, after 10 years or more, most recipients revert back to negative. Therefore, it is impossible to predict the TST outcome for BCG vaccines. Providers treat these patients the same as any other positive or negative reactor.

#### *Reactors and converters*

A positive reactor is a person who reacts positively to skin testing under current CDC guidelines. Each measurement varies depending on the individual risk factors of the person being tested. The area of induration is the area of palpable swelling around the site of injection. All reactions should be recorded in millimeters of induration, even those with a negative reaction. The size of the reaction and the patient's individual risk factors are the basis for determining the need for preventive therapy. The size of the reaction refers to the induration (or raised area), not redness.

A converter is a person whose PPD within a 2-year period shows a 10-millimeter (or greater) increase in induration for those under age 35; or a 15-millimeter (or greater) increase in induration for those over age 35. The conversion period is significant because it helps define the exposure period for the converter to a potential case.

Skin test reactions are considered positive indefinitely, unless the positive reaction is the result of a BCG vaccination. The TST indicates exposure to tuberculosis, however, it does not confirm active tuberculosis. The patient requires a full medical history, chest x-rays, laboratory tests, and an evaluation by a provider. The provider makes a determination after evaluating the patient's laboratory tests and physical findings.

#### *Chest x-rays*

Since absence of a lesion is necessary to rule out active disease, chest x-rays are performed on all reactors and converters to rule out pulmonary TB. The lungs are the most common site for TB disease — approximately 85 percent of TB cases are pulmonary. Since it is difficult to identify a lesion on x-ray, a chest x-ray by itself does not confirm a diagnosis of tuberculosis. If active disease is strongly suspected, a culture should be performed.

#### *Sputum cultures*

The growth of *M. tuberculosis* by laboratory culture is absolutely essential for a provider to confirm a diagnosis of tuberculosis. Cultures are obtained by asking the patient to cough up sputum or fluid from the lungs over a 3-day period. If a patient is unable to cough up sputum, it is possible to recover bacilli from stomach secretions. If the patient is symptomatic, has a positive TST, shows a chest lesion on X-ray, and is culture positive, a positive diagnosis of active tuberculosis can be made.

#### **Treatment**

Asymptomatic patients with positive TSTs, are at higher risk for developing active TB. Therefore, these people receive preventive therapy with Isoniazid (INH). Patients take this medication daily for 6 months. The purpose of the medication is to render the bacteria harmless. The patient's provider makes the decision to treat the patient with INH. Public Health usually has a healthcare provider in the MTF that is appointed by the MTF commander as the consultant for tuberculosis patients.

If the patient's provider has questions regarding the treatment, the program consultant should be contacted. Patients taking INH require close monitoring because of the side effects associated with the medication, the most serious of which is drug-induced hepatitis. Monthly monitoring of the aspartate aminotransferase (AST) is performed on patients over 35 years old, but considered unnecessary for younger patients, unless they have other health problems, as outlined in AFI 48-115.

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***Signs and symptoms of INH toxicity***

PH instructs all patients on the signs and symptoms associated with liver damage and INH toxicity. Signs and symptoms of hepatitis or INH toxicity include unexplained loss of appetite, nausea, vomiting, fatigue, unexplained weakness or fever for more than 3 days, dark urine, jaundice, rash, or numbness and tingling in the hands and feet. PH instructs patients to stop taking the INH and call their healthcare provider immediately if they experience such symptoms. The healthcare provider conducts a complete battery of liver tests and removes the patient from INH therapy if any LFT exceeds three times the upper limit of normal for that test.

Not all patients are able to take INH. Contraindications to treatment with INH include a history of liver damage associated with previous INH treatment, drug reactions such as drug fever, rash, and arthritis. Treatment of pregnant women is sometimes delayed until after delivery.

***Special attention required***

Some patients require special attention to ensure they do not develop INH-induced hepatitis. These patients include those on long-term medications, epileptic patients on medication, daily alcohol users, patients who suffer from chronic liver disease, and anyone who has been taken off INH without related side effects. Patients suffering from peripheral neuropathy or a contributing condition, such as diabetes or alcoholism, which predisposes them to peripheral neuropathy, also bear close monitoring. These patients require liver function tests more often than once a month. Patients with active tuberculosis receive a combination of drugs under the direction of a provider.

***Administrative requirements***

In accordance with requirements of the Tuberculosis Detection and Control Program, PH has two primary responsibilities: (1) oversee the administration of the program and (2) educate personnel about the disease. Patients with positive skin test reactions require education about tuberculosis, the meaning of test results, and medical follow-up. PH monitors patients to ensure they receive prescribed medication (INH) and follow-up liver function tests as necessary, if placed on INH. You do not want patients to “fall through the cracks” by receiving less than quality care and education.

***Follow-up***

After PH personnel educate the patient about the disease, the patient gets a baseline chest x-ray and liver function test before the initial appointment with the provider. The provider determines the most appropriate follow-up for the patient. PH does not diagnose or treat patients! However, PH ensures the paperwork is complete and accurate.

***Forms***

During the initial interview, PH personnel initiate the AF Form 2453, Tuberculosis Detection and Control Data (fig. 2-1). This form is used to record personal information, skin test history, chest x-ray reports, and the provider's recommendations for medical management of the patient. The provider closes out the form when the patient completes the required follow-up. The original form is filed in each patient's outpatient medical record. However, PH can maintain a working copy in the office until the patient completes the treatment. As monitor for the program, both the provider and PH review laboratory and chest x-ray results.

***Annual report***

Each medical facility must forward an annual report of the Tuberculosis Detection and Control Program to the MAJCOM. The format in AFI 48-115 explains the requirements.

TUBERCULOSIS DETECTION AND CONTROL DATA									
(THIS FORM IS AFFECTED BY THE PRIVACY ACT OF 1974 - Use Blanket PAS DD Form 2005)									
NAME OF PATIENT (Last, First, Middle Initial)				GRADE	SSAN	DOB	SEX		
Romero, Beavis B.				E-6	001-01-0101	1 Apr 59	<input checked="" type="checkbox"/> MALE <input type="checkbox"/> FEMALE		
STATUS			ORGANIZATION AND DUTY PHONE			HOME ADDRESS AND PHONE NO.			
<input checked="" type="checkbox"/> MILITARY <input type="checkbox"/> FLYING <input type="checkbox"/> CIVILIAN			SAM / GH 4-2058			April Fools Lane San Antonio, Tx 78200 (210)100-1001			
FOREIGN NATIONAL									
0-19									
NAME OF SPONSOR (If Patient is a dependent)									
SKIN TEST INFORMATION					CLASSIFICATION OF PATIENT				
TYPE	DATE	RESULTS							
LAST NEGATIVE	1 Apr 93	Negative	<input type="checkbox"/> POSITIVE REACTOR (No previous test or unknown) <input type="checkbox"/> INTIMATE CONTACT WITH ACTIVE TB CASE <input type="checkbox"/> CASUAL CONTACT WITH ACTIVE TB CASE <input checked="" type="checkbox"/> CONVERTER <input type="checkbox"/> OTHER (Explain)						
SCREENING (State Type)									
INTERMEDIATE PPD	1 Apr 94	positive 15x15mm							
MEDICAL HISTORY									
CHEST FILMS	DATE	RESULTS							
	1 Apr 94	No other changes							
RECOMMENDED FOR INH CHEMOPROPHYLAXIS									
<input checked="" type="checkbox"/> YES	DATE STARTED	<input type="checkbox"/> NO	REASON						
	6 Apr 94		⊕ PPD, Recent Converter						
CASE CLOSURE INFORMATION						DATE OF CLOSURE			
REASON (Check applicable block)									
COMPLETION OF ADEQUATE THERAPY									
SUPERVISION NO LONGER NEEDED									
DATE INH COMPLETED									
ALLERGIC REACTION									
REFUSED SUPERVISION									
ELEVATED SGOT'S									
OTHER (Explain in Remarks)									
TYPED NAME OF CLOSING PHYSICIAN					SIGNATURE				

AF 2453 PREVIOUS EDITION IS OBSOLETE

Figure 2-1. AF Form 2453, Tuberculosis Detection and Control Data.

Figure 2-1. Sample, AF Form 2453.

## Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

### 209. Respiratory diseases

1. What is meningitis?
2. What is the most serious type of meningitis?
3. What type of meningitis has an effective vaccine?
4. What is the most common type of meningitis?
5. Why is it important to treat streptococcal sore throat infections?
6. What are *minor* changes to an influenza virus commonly called?
7. What is the purpose of the Influenza Surveillance Program?

### 210. Pulmonary tuberculosis

1. What is tuberculosis?
2. What is the causative organism of tuberculosis?
3. How is tuberculosis spread or transmitted?
4. What are the three stages of tuberculosis?

5. What occurs during the dormant phase of tuberculosis?
6. What are the symptoms of active tuberculosis?
7. What test is used to screen Air Force personnel for tuberculosis?
8. When do positive reactions to the Mantoux test occur?
9. What does the acronym BCG stand for?
10. What is the purpose of a BCG vaccination?
11. What is the effect of a BCG vaccination on TSTs?
12. What test is used to *confirm* active tuberculosis?
13. What medication is used to prevent active tuberculosis?
14. What is the most serious side effect of Isoniazid?
15. What are PH's two primary responsibilities for managing the Tuberculosis Detection and Control Program?

## 2-2. Sexually Transmitted Diseases

An important part of the communicable disease program is the prevention and control of sexually transmitted diseases. Before you educate other people about a disease and how to protect themselves, you must be knowledgeable about the disease. This section provides some basic information about sexually transmitted diseases (STD). Do not use this volume as your only source of information on the clinical aspects of the diseases. There are many good resources for further study; however, material provided in this section is a good beginning.

### 211. Syphilis

Syphilis is a sexually transmitted disease that occurs in both an acute and chronic form. The acute form is characterized by primary stage lesions known as chancres, a secondary stage with characteristic skin rashes and mucous membrane eruptions as well as long periods of latency, without symptoms. The late stage of syphilis may be present as a chronic disease involving the central nervous system and the cardiovascular system. It is also possible for a pregnant woman to pass the infection to her unborn baby.

#### Causative agent

The spirochete *Treponema pallidum* causes syphilis. It is a thin corkscrew-like organism with a characteristic motion that is recognizable during laboratory examination. It penetrates intact mucous membranes easily; however, it does not invade intact skin successfully.

#### Mode of transmission

Transmission occurs during close sexual contact with a person who has an infectious lesion or chancre. The organism requires the moisture and warmth of the human body, is short-lived outside the human body, and is killed easily by soap and water. Therefore, inanimate objects are not significant in the transmission of the organism. It is possible to acquire the infection by accidental inoculation of the organism or by blood transfusion. However, since all blood donations are screened for syphilis, it is not a usual source of infection in this country. Because pregnant women pass the infection on to their unborn children through the fetal circulation, they are normally screened for syphilis during the prenatal period.

#### Incubation period

The incubation period of syphilis varies from 10 to 90 days, with an average of 21 days. Unfortunately, syphilis is not detectable by laboratory testing until the primary stage. During the incubation period, patients usually have a negative blood test.

#### Diagnostic techniques

There are three different methods of diagnosing syphilis. They include darkfield microscopy, serological testing, and cerebrospinal fluid examination.

#### Darkfield microscopy

The most specific means of identifying syphilis in the primary stage is through darkfield microscopy. *T. pallidum* is not easy to stain by ordinary laboratory methods, and the bacterium is similar to other spirochetes. *T. pallidum* must be in its living state to observe its structure and motility. The darkfield microscope is used, since the organism cannot be seen with an ordinary microscope. Spirochetes are very fragile and require immediate examination. Only specially trained laboratory personnel should perform darkfield microscopy, since the bacteria are easy to misidentify. This method is useful in confirming a diagnosis of syphilis only if the patient has a chancre with spirochetes. A negative examination does not mean the individual is free of syphilis. The numbers of spirochetes may be low or the individual may be in the latent stage.

***Serologic tests***

The body forms two types of antibodies in response to *T. pallidum* infection. One antibody develops against the organism itself, and the other antibody, known as reagin, results from the interaction of the organism with the body tissue. As a result, there are two types of serologic tests for syphilis (STS). Nontreponemal tests measure reagins and treponemal tests measure antibodies to the organism itself.

***Nontreponemal tests***

There are several types of nontreponemal tests. One of the most effective tests is the test developed by the Venereal Disease Research Laboratories (VDRL). This test is well-controlled, easy to perform, inexpensive, and widely available. The results are reported as reactive, weakly reactive, and nonreactive. A second test that is similar to the VDRL is the Rapid Plasma Reagin Circle Card Test (RPR). It is a modified VDRL test that introduces charcoal into an antigen suspension making the reaction between the antibody and the antigen visible to the naked eye.

***Treponemal tests***

These tests are more specific than nontreponemal tests and more useful in confirming a diagnosis of syphilis and identifying individuals with false positive nontreponemal tests. These tests are more complicated and expensive and are not meant to replace the VDRL or RPR as a screening test. The two types of treponemal tests used in the United States are the fluorescent treponemal antibody-absorption (FTA-ABS) test and the microhemagglutination assay for *T. pallidum* antibodies (MHA-TP) test. The FTA-ABS is more popular and reported as reactive, nonreactive, and borderline. The MHA-TP test is cheaper, simpler to use and read, and does not require fluorescent microscopy. However, the MHA-TP is less sensitive in the primary stage of syphilis than the FTA-ABS. The FTA-ABS is used to confirm infection with *T. palladium*. Because it is an antibody test, patients who were adequately treated for syphilis will have a positive FTA-ABS for life. The treponemal tests are of little help in identifying active infection in patients who have had prior syphilis infections. Healthcare providers use test results (VDRL and RPR) along with clinical symptoms to diagnose new syphilis infections.

***Cerebrospinal fluid examination***

If syphilis is suspected of attacking the central nervous system (CNS), a cerebrospinal fluid examination is necessary. The examination includes three parts: a VDRL, a cell count, and a total protein. All three tests must be performed to arrive at an accurate diagnosis.

***Symptoms and stages***

Syphilis occurs in stages classified as primary, secondary, latent, late, and congenital. As a public health journeyman it is your responsibility to conduct patient and contact interviews, conduct follow-up, and educate patients and contacts about their infections and how to prevent reinfection in the future. Consequently, you must have a very thorough understanding of the stages of the infection if you are to conduct a good interview.

***Primary***

The incubation period for the primary stage of the infection is 10 to 90 days, with an average of 21 days, after exposure to an infected partner. The first clinical sign of syphilis is a lesion that forms at the site where the spirochete entered the body. This lesion (or chancre) occurs anywhere in the genital area. In men, the chancre is usually visible as a single, painless lesion on the penis, meatus, or scrotum. However, for women, it is painless, and goes unnoticed if located in the vagina or on the cervix. Chancres occur around the anus of people who practice anal intercourse and on the lips or inside the mouth of those practicing oral sex. Because the chancre is painless and there are no symptoms of systemic infection, many people ignore the lesion, or treat themselves with home remedies. Some people never realize they have a lesion and progress to the secondary stage of the infection.

Chancres resolve within 1 to 4 weeks, with or without treatment; and it is not unusual for the serologic test for syphilis to be negative during this stage. During this primary stage, syphilis is not confined to the chancre, however. Spirochetes travel throughout the body including the lymphatics, blood, and other body organs.

### ***Secondary***

Usually within 4 to 6 weeks after the primary lesion appears, the patient enters the second stage of syphilis. However, this stage could begin as soon as the primary lesion disappears, or as much as several months after the lesion disappears. The clinical signs of this second stage are varied and may affect any organ of the body. The diagnosis usually is dependent on identification of skin and mucous membrane lesions. These lesions may simulate any type of skin lesion. The syphilis lesions are usually symmetrical and found bilaterally, commonly on the palms of the hands and the soles of the feet. Secondary manifestations resolve spontaneously within weeks, up to 12 months, leading to latency.

#### ***Other manifestations***

Other manifestations sometimes present during this stage are mucous patches, condylomata lata, alopecia, and adenitis.

1. Mucous patches consist of a slight erosion on the mucous membranes of the mouth, usually on the inside of the lips. Other mucous membranes affected are in the throat and cervix. These patches are loaded with the bacteria and are highly infectious.
2. Condylomata lata is a raised, table-top or mushroom-like papule, occurring on the genitals or rectum. It is usually pale in color, with a whitish, soggy appearance, and should not be confused with the drier, velvety surface of venereal warts. These lesions are very infectious.
3. Alopecia is a thinning of the scalp hair, usually described as “moth eaten.” The hair on the eyebrows and eyelashes is also thinned or falls out. This condition is only temporary, as the hair growth returns after the second stage is over.
4. Adenitis is an enlargement of lymph nodes in the inguinal, epitrochlear, axillary, and cervical regions. The nodes are not inflamed or tender.

#### ***Other clinical signs***

Along with these manifestations, other clinical signs of secondary stage consist of a mild fever, slight malaise, anorexia, headache, sore throat, myalgia, arthralgia, and aching bones. These signs may be overlooked during the diagnosis. The symptoms usually disappear after about 4 to 12 weeks, usually without scarring.

### ***Latent***

In this stage, the patient has no clinical signs of infection. This stage is divided into two parts. First, the *early* latent stage starts when the secondary lesions disappear. This early latent stage continues for 4 years, with 75 percent of the patients remaining asymptomatic. Twenty-five percent of the patients have relapses into the secondary stage and can infect other individuals. Because of these relapses, this early latent stage is included in the definition of infectious syphilis. Most of these relapses occur within the first year after secondary syphilis. The *late* latent stage starts at the 4-year mark after the latent stage first began. The patient may live with the late latent stage and remain asymptomatic for life, or this late latent stage could last until the late stage of syphilis begins.

**Late**

The late stage of syphilis is considered the destructive stage of the disease. It is noninfectious and involves any organ or tissue in the body. It has been called the “great imitator” since it can produce signs of almost any other disease; however, it usually involves the cardiovascular and central nervous systems. The late stage in the CNS can be diagnosed and managed, but late cardiovascular syphilis is usually identified too late for the patient to survive. The late stage also can affect the skin and bones; however, these two forms of late-stage syphilis are less common.

**Congenital syphilis**

The term “congenital” is not as accurate as the term “prenatal” in describing the transfer of the disease to a fetus. The spirochete usually crosses the placenta between the sixteenth and eighteenth week of pregnancy. Prior to this time period, the Langhan’s cell layer of the placenta acts as a barrier to the spirochetes. This layer breaks down after the eighteenth week, allowing the bacteria to infect the fetus.

Congenital syphilis is divided into two basic stages, early and late congenital syphilis. There is no primary stage since the bacteria is transferred directly into the blood stream of the fetus.

1. The early congenital syphilis stage produces signs and symptoms before the child is 2 years old. If the symptoms appear within the first few weeks of life, a poor prognosis usually results. The signs include cutaneous lesions, mucous membrane lesions, poor development of the long bones, anemia, and an enlarged liver or spleen. Almost 50 percent of the patients have CNS problems related to the disease.
2. The late congenital syphilis stage is defined as congenital symptoms persisting beyond 2 years of age. This stage is not infectious and can be similar to latent syphilis in adults. However, there are some symptoms that might appear. These symptoms include dulling of the cornea, Hutchinson’s teeth, maldevelopment of the first molar teeth, eighth nerve deafness, neurosyphilis, and bone development problems such as saddle nose configuration or a poorly developed hard palate. Other signs include cracks or fissures around the mouth, cardiovascular lesions, and painless swelling of the joints. These signs may develop before puberty or as late as middle age.

**Treatment**

The treatment of choice for syphilis is penicillin, except for patients who are allergic to the medication. Providers should refer to the “STD Treatment Guideline” published by the Centers for Disease Control for the most current treatment recommendations. The guidelines include medication alternatives for patients who cannot take penicillin. All tests, treatments, and follow-up actions are documented on a Standard Form 602, Syphilis Record (figs. 2-2A and 2-2B).



SECTION IV.--CUMULATIVE LABORATORY SUMMARY									
RESULTS OF DARKFIELD EXAMINATION									
	DATE	RESULTS	SOURCE OF SPECIMEN	LABORATORY	NAME OF CONFIRMING OFFICER				
1									
2									
RESULTS OF SERIOLOGICAL TESTS FOR SYPHILIS									
	DATE	TYPE	RESULT (Include titer value)	LABORATORY		DATE	TYPE	RESULT (Include titer value)	LABORATORY
1	9 Jun 94	RPR	1:16	Brooks	5				
2	27 Sep 94	RPR	1:8	Brooks	6				
3	27 Dec 94	RPR	1:4	Brooks	7				
4					8				
FLUORESCENT ANTIBODY TESTS									
	DATE								
1	9 Jun 94	IFA-ABS Reactive							
2									
RESULTS OF SPINAL FLUID EXAMINATIONS									
	DATE	CELLS	TOTAL PROTEIN	SEROLOGICAL TESTS (Including titer)				LABORATORY WHERE DONE	
1									
2									
SECTION V.--EVALUATION OF THERAPY									
	DATE	FACILITY WHERE EVALUATED	RESULT		DATE OF RETREATMENT	PHYSICIAN'S SIGNATURE			
			Satisfactory*	UNSATISFACTORY**					
1									
2									
3									
4									
*Satisfactory result cannot be reported without normal spinal fluid findings.									
**Specify: Infectious Relapse: sero-Relapse, Neuro-Relapse, Incomplete data on Spinal Fluid, Other (Specify)									
REASON FOR INADEQUATE FOLLOW-UP (Date, place and type of separation---Give authority for discharge)									
PATIENT'S HOME ADDRESS ON SEPARATION					CIVILIAN HEALTH DEPT. TO WHICH CASE RESUME WAS SENT				
					San Antonio Metro Health Dept.				
REINFECTION (Give date new record was opened)									
REMARKS (Include significant posttreatment clinical findings)									
SECTION VI.--MEDICAL OFFICER CLOSING THIS RECORD									
J.R. Physician NAME (Typed or printed)			J.R. Physician SIGNATURE		Brooks AFB STATION		27 Dec 94 DATE		
SECTION VII.--MEDICAL OFFICER SENDING ABSTRACT TO VETERANS ADMINISTRATION ON DISCHARGE									
NAME (Typed or printed)			SIGNATURE		STATION		DATE		

Figure 2-2B. Sample, SF 602 (back).

### Follow-up

Post-treatment follow-up is essential to the proper management of syphilis patients. Unfortunately, many providers believe that, if a patient is treated with the recommended dosage of penicillin, a cure is assured and follow-up unnecessary. Although penicillin is effective, treatment failures do occur, making retreatment necessary. Additionally, alternative antibiotics can be less effective making follow-up essential.

Follow-up for syphilis consists of periodic serological testing. Quantitative VDRLs are performed at 1, 3, and 6 months after treatment for primary and secondary syphilis. Patients treated during the latent phase are also tested at 6 and 12 months. Most patients treated during the primary stage revert to a nonreactive state within 6 to 12 months after treatment, although, some take as long as 1 to 2 years after treatment. Late latent or late syphilis patients may have a high titer (called sero-fast) although the titer may reduce some over time.

In such cases, a VDRL should be performed on the spinal fluid. If the titer rises during follow-up, this may indicate treatment failure or reinfection. The distinction may be difficult to prove. A patient interview and investigation may be helpful in determining whether treatment failed or reinfection occurred.

### Prevention and control measures

Since syphilis is only communicable during the primary and secondary stages (and relapses during early latent stage), the emphasis of PH should be placed on identifying and treating all cases of primary and secondary syphilis. The emphasis should be placed on any case of syphilis less than 2 years' duration, all cases of early congenital syphilis, and all women having syphilis during pregnancy. Early diagnosis and treatment is difficult, since early syphilis rarely causes acute illness and the lesions often heal spontaneously. Many patients with primary syphilis treat themselves with nonprescription drugs and do not see a healthcare provider. Other prevention and control procedures are similar to any other STD.

## 212. Gonorrhea

Gonorrhea is one of the most common STDs. It is complex and dangerous because the medical and laboratory aspects keep changing. For example, the has organism developed resistance to many antibiotics and, therefore, the laboratory testing has changed over the years. This makes it difficult to keep current with the patient education information and the treatment guidelines for the disease.

### Causative agent

The organism causing this infection is *Neisseria gonorrhoeae*, a spherical or oval gram-negative bacterium known as a gonococcus. In the discharge fluid, these organisms appear as ovoid diplococci; they rarely appear as single cells.

### Mode of transmission

Gonorrhea is spread from one individual to another by intimate penile, vaginal, oral, or rectal contact with an infected person. *N. gonorrhoeae* attacks mucous membranes of the penis, vagina, rectum, urethra, or throat. The gonococcus dies quickly in air; thus, it is almost impossible to contract gonorrhea from inanimate objects used by an infected person. The gonococcus travels from the mucous membranes of the infected partner to the uninfected partner's mucous membranes; however, it does not always infect the uninfected partner. Organisms often die during sexual contact, making the chances of catching gonorrhea during a single exposure about 50 percent. Of course, repeated sexual contact with an infected person greatly increases the chances of becoming infected.

## Symptoms

It is necessary to separate the symptoms into three areas: male genital, female genital, and nongenital infections.

### *Male genital*

Common terms often used to describe urethral gonorrhea, such as the drip, burn, and clap, actually explain how the disease affects the penis. The two categories of male genital gonorrhea are uncomplicated and complicated.

#### *Uncomplicated*

When the gonococcus enters the mucous membranes of the penis, the body responds with white blood cells to attack and consume most of the bacteria. However, the bacteria quickly overpower the body's natural defenses. About 2 to 7 days after contact, the incubation period, gonorrhea causes a thick, whitish-yellowish discharge of pus (drip) from the penis. This discharge consists of dead urethral cells, bacteria, and white blood cells. The meatus becomes swollen, causing the lips of the meatus to come closer together (clap), making urination difficult and painful (burn). Sometimes a drip without burning or burning without a drip will occur. Either should be reported to a healthcare provider. Some men are asymptomatic or do not show signs or symptoms. These men do not seek medical attention and are a major factor in the continual spread of the disease.

#### *Complicated*

If untreated, the typical symptoms of gonorrhea will eventually disappear, but the individual is still infected with the disease. The bacteria travels up the urethra and infects other organs in the reproductive system, such as the prostate gland. Pain during urination becomes more severe and is felt in the entire penis, not just the meatus. In some cases, an abscess may form in the prostate gland causing a feeling of heat, pain, or swelling in the lower pelvis or around the anus. Other symptoms include severe pain when moving the bowels and a high fever. The enlarged prostate presses on the bladder, making it difficult or impossible to urinate. The abscess eventually breaks down into the urethra or rectum, releasing pus. However, most men do not develop the prostatic abscess, and the untreated disease can continue for a long time causing only minor symptoms.

- Untreated – In about 20 percent of the men who remain untreated for longer than a month, the bacteria spread down the vas deferens (the tube leading from the prostate to the testicles), reach the epididymis on the back of one or both of the testicles, and cause gonococcal epididymitis. Epididymitis, which occurs more commonly on the left side, causes pain in the groin, a heavy sensation in the affected testicle, and the formation of a small, hard, painful swelling at the bottom of the testicle. The overlying skin of the scrotum becomes red, hot, and painful.
- Treated – Even when treated, gonococcal epididymitis leaves scar tissue which closes off the passage of sperm from the affected testicle. Since epididymitis is usually restricted to only one testicle, even such advanced gonococcal infection does not often lead to sterility. However, if the infection is left untreated, both testicles become involved, and the man is left sterile. Complications of gonorrhea in the male are extremely rare, and even when treatment is delayed, total recovery is the rule.

### *Female genital*

Gonococcal infections in the female are more difficult to identify based on symptoms. Both uncomplicated and complicated gonorrhea infection can occur in females.

### *Uncomplicated*

The infection may cause an unusual vaginal discharge; however, this discharge is hard to distinguish from that which normally occurs during sexual excitement, ovulation, a few days before menses, or during pregnancy. Occasionally a burning sensation may occur during urination. Approximately 80 percent of cases in women are asymptomatic. Therefore, it is very important for men with symptoms to notify their female sexual partners immediately and for women to seek a medical examination for gonorrhea.

### *Complicated*

Complications can also occur in the female, if the infection goes untreated. Gonorrheal pelvic inflammatory disease (PID) is the most common and most serious complication of gonorrhea infections, occurring in about 50 percent of the untreated cases of uncomplicated gonorrhea. Because uncomplicated gonorrhea does not produce noticeable symptoms in most women, the infection is often not treated. If treatment is delayed for more than 8 to 10 weeks, the bacteria may travel into the uterus.

During menstruation, the bacteria can multiply rapidly in the dead cells and blood of the uterine lining, spreading quickly up the sides of the uterus and attacking the inner walls of the fallopian tubes (fig. 2-3). This infection of the fallopian tubes is called "salpingitis." Infection may block the fallopian tubes, allowing pus to collect. As infection builds, the tubes become grossly enlarged. Even after the infection resolves, the fallopian tubes frequently remain blocked with scar tissue, often resulting in sterility.

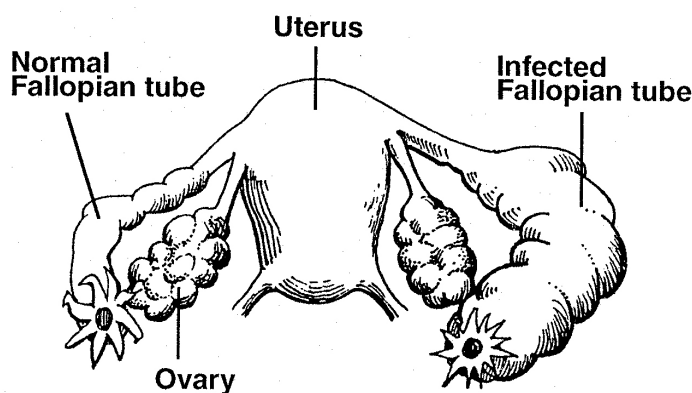


Figure 2-3. Fallopian tubes.

The infection can also travel out of the fallopian tubes and invade the pelvic cavity. When this occurs, the pelvic tissues become swollen and inflamed. A woman with gonococcal PID may experience one or more of the following symptoms: lower abdominal pain, pelvic tenderness, elevated temperature, dysuria (painful or difficult urination), vaginal discharge, nausea, and vomiting.

- Treatment

Antibiotics are the treatment for PID. However, the damage already done cannot be repaired, and the pelvic organs never fully recover. Some women may have chronic mild to moderate lower abdominal pain which may worsen during menstruation or sexual intercourse, fatigue, or constipation.

- Pain and surgery

Some women who suffer from PID may experience repeated attacks of severe lower abdominal pain and may ultimately require a hysterectomy (removal of uterus), salpingectomy (removal of tubes), or oophorectomy (removal of ovaries) for relief.

**Nongenital gonorrhea**

Gonorrhea can attack organs other than the genitals. It can infect the rectum, pharynx, conjunctiva, and the bloodstream. In females, infective heavy discharge or menstrual blood may be manually transferred to the rectum and result in infection. Although it usually does not cause symptoms, rectal gonorrhea, may produce rectal mucous discharge, intense rectal irritation, a feeling of incomplete evacuation after defecation, and burning pain during defecation or anal intercourse. However, these symptoms are also often associated with men who practice anal intercourse and do not have gonorrhea. Rectal contacts of persons with penile gonorrhea should receive treatment, since medical examination and diagnostic cultures may not detect rectal gonorrhea.

**Pharyngeal**

Another form of gonorrhea is pharyngeal gonorrhea, or oral gonorrhea. People with this form of gonorrhea are usually asymptomatic. However, if symptoms develop, they may include a mild to severe sore throat, fever, and chills.

**Ophthalmia**

The third type of nongenital gonorrhea is gonococcal ophthalmia neonatorum, which occurs in newborn infants. The infant's eyes get infected as the infant passes through the birth canal of the infected mother. Symptoms include intense redness, swelling, and a discharge usually occurring within 3 days of birth. The infection usually occurs bilaterally, and if untreated, may lead to corneal ulceration or orbital cellulitis (inflamed tissues of the eye orbit). To prevent infection, all newborns in the United States hospitals have silver nitrate drops placed into their eyes immediately after birth.

**Septicemia**

When the gonorrhea bacteria leave the genital area or anal canal and enter the bloodstream, gonococcal septicemia develops. This form of gonorrhea is rare, but it does occur in women and homosexual males who are more likely to be asymptomatic and not seek medical treatment. The presence of the bacteria in the bloodstream can cause symptoms such as fever, malaise, loss of appetite, arthritis, and dermatitis. Arthritis is common in asymptomatic cases. Eventually, the bacteria may invade the heart, liver, and central nervous system, even though only a few of these cases have been reported in the past few decades.

**Diagnostic techniques**

Making the diagnosis of gonorrhea usually involves getting a history of signs and symptoms and identifying *N. gonorrhoeae* in body secretions. The most reliable method of diagnosis is to find the organisms by smear or culture.

The gram-stain is the preferred method for evaluating smears. The diagnosis can be made if gram-negative intracellular diplococci are found in stained films of the discharge sample.

Although the smear is sufficient to identify the presence of gonorrhea in symptomatic patients, cultures are generally necessary to confirm the diagnosis, especially in asymptomatic patients and contacts. Smears are not as reliable as cultures in female patients. Cultures are grown in a selective medium specifically designed to prohibit the growth of organisms such as *Proteus* species, which are normal flora in the rectum. Routine culture sites for males are the urethra, rectum, and pharynx. Routine culture sites for females are the cervix, rectum, and pharynx. If no *N. gonorrhoeae* is identified after 48 hours, the culture is considered negative.

**Treatment**

If a culture is positive, the patient needs treatment. All cases of gonorrhea are treated according to the latest edition of “Sexually Transmitted Disease Treatment Guidelines” published by the Centers for Disease Control (CDC). When a new version of the treatment guidelines is published, someone in your office should ensure that all professional staff members are aware of the changes in treating STDs. Everyone in PH should review this publication to be aware of the current treatment regimens. This is necessary to properly educate the patient about their treatment and follow-up.

There are several factors the healthcare provider considers prior to selecting a course of treatment. There are many antibiotics that can be effectively used against the different types of gonorrhea. These antibiotics include procaine penicillin, tetracycline, ampicillin, amoxicillin, spectinomycin, and cefoxitin for penicillin resistant strains.

***Patient acceptability***

Patients may not want to comply with the instructions for taking their medication. This may make your surveillance and follow-up very difficult to conduct. The patient’s attitude may influence the provider’s selection of oral or injectable antibiotics.

***Patient reliability***

If a patient indicates difficulty in taking multi-dose medications or the reliability of the patient is in question, a single-dose injection may be ordered by the healthcare provider.

***Medication effectiveness***

The antibiotic must be effective for the type of gonorrhea encountered. Some antibiotics are effective against urogenital gonorrhea, but are not effective against pharyngeal infections. Also, some strains of gonorrhea are resistant to penicillin. Resistant strains are called penicillinase-producing *Neisseria gonorrhoeae* (PPNG). These strains produce beta lactamase, an enzyme which makes them totally resistant to penicillin. The military population is at an increased risk of exposure to PPNG due to the assignments to areas of the world where these strains are endemic.

***Medication side effects***

Some medications such as tetracyclines create side effects in some individuals. For example, using tetracycline for treating young children would cause yellowing of the teeth and in pregnant women it creates a possibility of teratogenic side effects. Alternative antibiotics should be used for people who are allergic to penicillin.

***Presence of other diseases***

Some medications are effective against gonorrhea, but not against syphilis. If a patient is positive for more than one STD, the healthcare provider should carefully select the antibiotics.

**Follow-up**

Persons who have uncomplicated gonorrhea and who are treated in accordance with the CDC STD treatment guidelines need not return for a test of cure. Only those patients with symptoms persisting after treatment should be reevaluated.

**Prevention and control**

Since gonorrhea is a widespread disease, it is important to pursue prevention and control measures. Many of the prevention and control measures are the same as for many other STDs. The goals are to ensure that all active cases are identified and treated appropriately and that all sexual partners have been contacted, tested, and treated. Another goal is to educate as many people as possible about the disease, including how the disease is spread, prevented, and treated.

**Prevention**

Although abstaining from sexual contact is the only 100-percent effective way to prevent STDs, this is not a very realistic approach. The next best thing is to use a condom. If a condom is used properly, gonorrhea, as well as most STDs, can be prevented.

**Control**

Other preventive measures include decreasing the number of sexual partners; keeping the name and telephone number of all sexual contacts (even casual sexual contacts) so that if an infection develops, all sexual contacts can be informed and treated for the disease; and restricting specific activities such as oral-anal sex, oral-genital sex, and anal and vaginal penetration to a few well known partners (who should restrict themselves as well). One additional preventive measure is visually checking a partner's sexual areas for signs of a discharge, sore, rash, or lesions that would warrant a delay until the partner is medically treated. One of your jobs is to educate patients to follow these preventive measures and to check themselves for bumps, sores, rashes, and discharges and to seek medical treatment if any signs of the disease are discovered.

**Other measures**

Other preventive measures, although not as effective, are also recommended. These include washing the genitals before and after each sexual encounter; urinating or douching after intercourse; and using topical spermicidal or bactericidal agents during intercourse.

**Education**

Educating the population on preventive measures and encouraging use of these measures will reduce the spread of disease.

**213. Chlamydia**

A chlamydia infection can affect the urogenital and reproductive tract of both men and women and the conjunctiva and lungs of newborn infants. This infection is just as serious as a gonococcal infection. Chlamydia infection in men is often called nongonococcal urethritis (NGU), and is discussed later in this unit.

**Causative agent**

The microorganism that causes the genital infection is *Chlamydia trachomatis* which is classified as a bacterium. However, chlamydiae share properties with both bacteria and viruses. Like viruses, chlamydiae only grow intracellularly which makes culturing difficult and expensive. Consequently some MTFs do not have the capability to culture it. Like bacteria, chlamydia contain both DNA and RNA, they divide by binary fission, and they have cell walls similar to gram-negative bacteria. Chlamydia infections are not always apparent, and many infected men and women may be asymptomatic.

**Mode of transmission**

*Chlamydia trachomatis* can be transmitted from one person to another during sexual intercourse with either the penis or vagina becoming infected. It has been isolated also from the pharynx and rectum from both heterosexual and homosexual men and women. The organism is also transmitted from the mother's birth canal to the newborn's conjunctiva during delivery.

**Incubation period**

The incubation period is 1 to 3 weeks, with an average of 7 to 14 days.

**Genital chlamydia**

Symptoms in men include an opaque discharge of small or moderate quantity, urethral itching, and burning on urination; women experience endocervicitis with a discharge of mucous and pus. These usually appear within 1 to 3 weeks after exposure. One of every two infected women and one of every four infected men may have no symptoms whatsoever. As a result, the disease is often not diagnosed until complications develop. Complications in men include epididymitis and urethral syndrome; complications in women include acute salpingitis and pelvic inflammatory disease (PID). It should be noted that the symptoms associated with PID caused by *C. trachomatis* are usually less severe than those caused by gonorrhea; however, the damage to the reproductive tract may be more severe than that caused by gonorrhea, thus increasing the risk of infertility and ectopic pregnancy.

**Nongenital chlamydia**

Conjunctivitis is the disease of the conjunctiva caused by *C. trachomatis*. In adults, there are variations of the infection, such as acute follicular conjunctivitis. These diseases, if untreated, may persist for a few months until trachoma develops. Trachoma is a chronic infectious disease of the conjunctiva and cornea, producing photophobia, pain, and excessive tearing.

Infants exposed to *C. trachomatis* in the mother's infected birth canal during birth may develop a number of diseases, such as conjunctivitis and pneumonia. Although conjunctivitis develops in a few days, the symptoms of pneumonia do not appear until the second month of life. Conjunctivitis and pneumonia are easily treated once the symptoms are noticed.

**Diagnostic techniques**

There are many techniques for diagnosing chlamydial infections. These include tissue cultures, cytology, and antigen detection by serologic testing.

***Tissue cultures***

Isolation in tissue culture is the standard test for chlamydia in the genitals. Since the bacteria grow intracellularly, a cell must be available for growth. Tissue cultures treated with specific chemicals to aid the growth of chlamydia are inoculated with a sample of tissue suspected of infection. The culture is incubated for 48 to 72 hours.

***Cytologic diagnosis***

Another method to identify chlamydia is to take skin scrapings from the patient and stain them to identify the organism. The skin scraping allows a quick diagnosis, because the results are known in a few moments and a culture does not have to be grown. The sample examined must be from the skin scrapings and not from any discharge to ensure enough epithelial cells are examined.

***Antigen detection***

The antigen-antibody reactions of the patient can be measured using an enzyme-linked immunosorbant assay (ELISA). This test does not depend upon a specially trained observer and has the ability to test large numbers of specimens at one time. This method is used to diagnose chlamydial infections in infants.

**Treatment**

The most common treatment for chlamydial infections is Doxycycline (100 mg) twice a day (b.i.d.) for 7 days, or Azithromycin (1 g) orally in a single dose. According to the Centers for Disease Control, either medication is at least 95 percent effective.

**Follow-up**

Since the medication is so effective and antimicrobial resistance to recommended treatments has not been observed, test-of-cure cultures are not necessary when treatment has been completed.

**Prevention and control**

Chlamydial infections are widespread and it is important to pursue prevention and control measures. The prevention and control measures are generally the same as for many other STDs. The goal is to ensure all active cases are treated effectively and that all sexual partners are contacted and treated as well. Again, the best preventive measure is the use of a condom. It is also important to visually check a partner's sexual areas for signs of a discharge, sores, rash, or lesions. As with other STDs, additional precautions include washing the genitals before and after each sexual encounter, urinating or douching after intercourse, and using topical spermicidal or bactericidal agents during intercourse.

**214. Other common sexually transmitted diseases**

Other common sexually transmitted diseases are genital herpes, nongonococcal urethritis (NGU), vaginitis, lymphogranuloma venereum, and pediculosis. You need to know about these diseases, so let's begin by learning about genital herpes.

**Genital herpes**

Genital herpes is a viral disease that usually affects sexually active people and newborns infected during birth. Herpes is a Greek word meaning "to creep." The virus has been around for centuries.

***Causative agents***

Herpes is caused by herpes simplex virus (HSV). There are two types of HSV: type one (HSV1) usually causes cold sores or fever blisters on the mouth and type two (HSV2) usually causes genital herpes. HSV2 invades the nerve cells of the genital area. After the initial infection, the HSV2 leaves the infected genital area and travels to the nerve cells that lie next to the lower part of the spinal cord. The virus lives here for the rest of the person's life. Periodically thereafter, reactivation of the virus within these nerve cells causes the virus to retrace its path back to the nerves of the initially infected site. It is possible for this relapse to occur years after the initial infection. Furthermore, such relapses may recur frequently or rarely. Due to the antibodies produced by the body to fight off the first invasion of the virus, the repeat episodes are generally not as painful and do not last as long as the initial infection.

***Mode of transmission***

The initial infection is contracted by close physical contact, usually intimate contact, with a person who has an active infection. The infection usually begins as small painful blisters which contain clear fluid. Some clear blisters become cloudy with pus. The blisters may break open to form shallow, painful sores which eventually scab over and heal completely. When these blisters or sores are present, a person is considered to be infectious and can transmit the disease. However, it is not known exactly when the virus is shed. The virus may be shed before, during, and after the blisters or sores are present. Generally, the person should be considered safe only after the sores have completely healed. Care should be taken if the sores have scabs, since the scabs can be rubbed off during sexual activity and the virus shed. The HSV2 has also been isolated in seminal fluid, cervical secretions, and in saliva of infected people. Herpes can be transmitted from any form of sexual contact including intercourse and oral-genital contact. Even the HSV1 has been found in the genital areas of infected patients.

***Incubation period***

After the initial infection, the virus incubates for about 2 to 12 days, with 6 to 7 days being the average incubation time.

### ***Symptoms***

As mentioned already, the first sign is usually blisters forming on the genitals, even though they can form anywhere. These blisters may break open, especially those in moist areas. The groin area may be swollen and painful. Surrounding areas may itch, and urination may be painful. There may be an increase in vaginal fluid discharge in women and generalized aches, pain, and possibly fever associated with the infection. These symptoms last for about three weeks for the first episode, while subsequent episodes may last for 2 to 9 days each. Subsequent episodes can exhibit symptoms ranging from a mild tingling sensation from ½ to 48 hours prior to an eruption to shooting pains in the buttocks, legs, and hips from 1 to 5 days before the blisters appear. Complications may occur such as encephalitis. Newborn infants who passed through an infected birth canal are susceptible to infection which can cause blindness, permanent nervous system damage including mental retardation, and possibly death. Even after the symptoms subside, the virus can be reactivated when the body's defense system has been weakened due to stress, illness, trauma, and overexposure to the sun. The triggering device for subsequent episodes is not yet understood.

### ***Diagnosis***

Viral isolation in tissue culture is the most specific and sensitive method of confirming a diagnosis of herpes. A serological test is available. However, this test is not as accurate, and it is usually only used for patients with the first (primary) herpes infection, since all patients seroconvert, that is, they build antibodies against the virus.

### ***Treatment and prevention***

There is no cure for this disease. However, the symptoms can be treated with a variety of medications. There are also a few medications used to slow or stop the transmission of the disease. Acyclovir is used to stop the virus from replicating or making new virus cells. It does not cure the infection nor does it prevent a reactivation. The best form of prevention currently, is education on to **NOT** be sexually active during or near episodes of blisters or sores.

### ***Nongonococcal urethritis (NGU)***

Nongonococcal urethritis is similar to gonorrhea in almost every respect except that the causes are different. This disease primarily affects men.

### ***Causative agents***

There are many causes of NGU including *Chlamydia trachomatis*, *Ureaplasma urealyticum*, herpes simplex virus (HSV), and *Trichomonas vaginalis*.

### ***Mode of transmission***

These organisms are transmitted sexually. Women become carriers of the disease and can infect the male partner through vaginal, anal, or oral-genital intercourse.

### ***Incubation period***

Unlike gonorrhea, NGU takes approximately 1 to 5 weeks to incubate with the average of 2 to 3 weeks. Some men are asymptomatic for months while the bacteria travels to the prostate or epididymis causing complications.

### ***Symptoms***

Common symptoms are urethral discharge, dysuria, and urethral itching. The discharge associated with NGU is usually noticed in the morning, as a crusted substance at the meatus or as stains on the underwear. The clinical examination is very important. A smear should be taken first thing in the morning prior to urinating. This ensures a sufficient sample to identify the causative agent. The sample is taken from either the discharge, or for more accurate results, from a urethral swab and stained for identification. If *C. trachomatis* is found, the patient is considered to be infected.

However, if *U. urealyticum* is found the patient does not necessarily have urethritis. The diagnosis must be based on the clinical symptoms as well as the laboratory findings. The treatment for NGU is usually 1 gram Azithromycin orally as a single dose, or Doxycycline for 7 days.

### **Vaginitis**

Vaginitis is an inflammation of the vagina and is one of the most common conditions associated with the female sexual organs. Although it may not be dangerous, vaginitis deserves immediate medical attention.

#### ***Causative agents***

The cause of vaginitis is commonly either *Trichomonas vaginalis* or *Gardnerella vaginalis*. *T. vaginalis* is a flagellated protozoan; *G. vaginalis* is an anaerobic bacteria. *T. vaginalis* infection in women is known as trichomoniasis.

#### ***Mode of transmission***

The organism is transmitted through sexual contact. It can be maintained by a male in either the foreskin of the penis or in the prostate gland without producing any symptoms. Infection is transmitted when the organism is rubbed off the penis onto the vaginal walls during intercourse. *T. vaginalis* can survive outside the body for up to 24 hours in tap water or other body fluids such as urine, semen, and vaginal exudates. In theory, if infectious material such as urine is deposited on a toilet seat and the next user's vagina makes contact with the contamination, infection might develop. However, this has never been documented. Also, if infected people share towels or wash cloths during or after showers, there might be a chance of spreading the organisms.

#### ***Incubation period***

The incubation periods vary with each organism, the dose of organism received, and the patient's susceptibility.

#### ***Symptoms***

Symptoms usually include a heavy, foul discharge that is white, yellowish, or greenish, and often frothy. Irritation of the vagina and vulva causing soreness and itching with frequent burning during urination are also symptoms associated with this condition. The pain and froth is less severe or not present with *G. vaginalis*. Treatment of trichomoniasis is usually metronidazole in a single dose. Again, check with the current CDC guidelines for treatment updates. If sexual partners are not treated at the same time as the patient, reinfection can occur. Cultures are not effective for diagnosing *G. vaginalis*. Thus, the diagnosis is usually based on clinical symptoms. Metronidazole is also used to treat *G. vaginalis*.

### **Lymphogranuloma venereum**

Lymphogranuloma venereum (LGV) is a sexually transmitted disease of the lymphatic system affecting both males and females.

#### ***Causative agent***

LGV is caused by several types of *C. trachomatis*. This organism is the same as the one causing the disease, chlamydia. The location of the infection along with the symptoms create a variation of the disease.

#### ***Mode of transmission***

LGV is transmitted through sexual contact such as vaginal and anal intercourse.

#### ***Incubation period***

The incubation period is variable, with a range of 3 to 30 days for primary lesion; however, if bubo is the first symptom, the incubation period is from 10 to 30 days to several months.

**Symptoms**

A small painless pimple-like sore appears on the sexual organs but disappears in a few days. Since the sore is painless, it often goes unnoticed if hidden in the foreskin of the penis or in the vagina. If untreated, in about 10 to 30 days, the chlamydiae travel to the lymph nodes of the groin area. The affected lymph node swells due to inflammation forming a bubo. The individual then may experience fever, chills, abdominal pains, loss of appetite, and joint pains. The bubo is very obvious and painful, making most people seek medical attention. If the bubo does not form or in those individuals who do not seek medical attention, more serious complications could develop. These complications may develop anytime between 1 and 10 years later. These complications include rectal stricture and tremendous swelling of the sexual organs, creating LGV elephantiasis.

**Diagnosis and treatment**

The diagnosis is based on clinical signs, as well as serological testing and/or tissue cultures of pus withdrawn from the bubo. LGV is usually treated with doxycycline (100 mg) orally b.i.d. for 21 days. Sometimes, surgical intervention is required for relief of a rectal stricture.

**Pediculosis**

Pediculosis is not *always* a sexually transmitted disease; however, it could be. Let's take a look at the various types of human pediculosis (louse infestation).

**Causative agent**

Lice are parasites that feed on human blood; and they are found everywhere, from the cold climates to the hottest parts of the world. They infest all types of people, and are found in crowded conditions where people cannot keep themselves and their clothing clean. There are three distinct varieties of lice that affect humans: *Pediculosis humanus capitis* (the head louse), *P. humanus corporis* (the body louse), and *Phthirus pubis* (the crab or pubic louse). All three varieties are similar anatomically. Each is small, flat, and wingless. The life cycle for the louse goes from ova (egg) to nymph (young louse) to adult.

**Mode of transmission**

Adult lice and nymphs are excellent travelers. Body and head lice can travel to other people very quickly by direct contact, or by contact with an infested person's personal items (e.g., a hat, hair brush, comb, clothing, or bedding). Body lice need a rough surface to grasp and are usually found in the seams of clothing, when they're not on a body. The pubic or crab lice only travel for short distances and hold onto the hair shafts with their powerful claws. Transmission of the crab lice is usually restricted to sexual contact.

**Incubation period**

Lice spend approximately 8 to 9 days in the ova stage. The nymph stage takes about 10 to 15 days. The life span of the head louse is about 30 days, while body and pubic lice live for about 35 days.

**Diagnosis**

While biting a person, a louse sucks blood from the individual. This bite wound becomes itchy and sometimes sore. Diagnosis is made by visually identifying the louse or by identifying the bite left by the louse. Head and pubic lice are found on an individual's body, while the body louse is found on their clothing. Nits (the egg case), regardless of the species involved, are tiny, white, cylinder shaped pods that attach to the hair shafts next to the skin.

To check for head lice, start looking at the back of the head and behind the ears, and then check the entire scalp. For body lice, check any body part that comes into contact with clothing, since the body louse spends very little time on the body to feed and spends the rest of the time on the person's clothing. Usually, you can see tiny bite marks on the victim's shoulders, between the shoulders, and around the waist. Pubic lice bites are most often present on the abdomen, lower thighs, and genitals. Pubic lice occasionally can be found in the armpits and on the eyelashes or eyebrows causing inflammation of the eyelids.

Other associated signs and symptoms include mild fever, muscular aches, and occasionally, swelling of the cervical glands. Pubic lice frequently exist with other STDs such as gonorrhea, syphilis, and trichomoniasis.

### ***Associated problems***

When discussing the incubation period of pediculosis, you cannot forget the problems associated with lice infestations. These problems, known as "lousy" diseases, could easily cause epidemics throughout a population if crowded conditions exist. Places where crowded conditions may exist include hospitals, jails, nursing homes, schools, summer camps, and dormitories. Different diseases associated with lice are typhus fever (a rickettsia), trench fever (a rickettsia), and relapsing fever (a spirochete). Louse-borne typhus outbreaks are most frequent during wars and natural disasters. The spread of this typhus is dependent on sanitation, abundance of lice, and crowded living conditions. There has not been an outbreak of typhus in the United States since the 1930s; however, there have been major outbreaks in many other parts of the world. Under wartime conditions such an outbreak could be a major threat for the military population since we are required to respond worldwide.

### ***Control***

Lice infestations can be controlled by treating the infested people and cleaning personal items and bedding. There are shampoos, lotions, or creams containing lindane that can be used to treat head or pubic lice. It is important to use a nit comb or other fine-tooth comb to remove the nits attached to the hair shafts. However, treating the individual alone will not control the lice. It is important to remove the lice from the clothing, bedding material, hats, combs, and hair brushes. These items can be cleaned using hot water and detergents. Lice can be removed from clothing by washing, dry cleaning, or ironing, giving extra attention to the seams. Fumigation of buildings is not necessary to control lice.

## **215. Acquired immunodeficiency syndrome (AIDS)**

AIDS is the term used to describe a group of symptoms that usually result from an infection with a virus. This disease has affected many people around the world and even created a panic situation in some places. The effects of this disease have single-handedly changed the sexual conduct of many people in our society.

### ***Causative agent***

The cause of AIDS is a retrovirus known as human immunodeficiency virus (HIV). The virus initially was called HTLV-III (Human T-Lymphotropic Virus Type III) in the United States and LAV (Lymphadenopathy Associated Virus) in France. At present, the universally accepted name is HIV. HIV stores its genetic material in the RNA. HIV infected cells use an enzyme called reverse transcriptase to copy the viral genetic material from RNA into DNA. This genetic information stays in the infected cell and continues to replicate more viruses that can infect other cells. HIV destroys the body's ability to defend against invading organisms since it attacks and destroys the T<sub>4</sub> (T-helper or CD<sub>4</sub>) cells and the macrophages/monocytes.

### ***Mode of transmission***

HIV can be transmitted by sexual contact (penis/vagina, penis/rectum, mouth/vagina, mouth/penis, or mouth/rectum) with an infected individual. The use of contaminated intravenous injection equipment such as needles and syringes can also infect a person. The virus can also be transmitted from an infected mother to infant child before, during, and after birth (in breast milk).

### ***Risk groups***

The groups at risk for acquiring HIV include homosexual and bisexual men; intravenous drug users; heterosexual partners of bisexuals or persons with HIV infection; institutional prisoners (due to homosexuality and IV drug use); prostitutes (due to sexual contact and IV drug use); and hemophiliacs who received blood products prior to 1985.

### ***Symptoms***

Since HIV infection usually affects the body's immune system, it allows many other diseases to invade the body and cause death. The 1987 revised CDC case definition for AIDS reads, "AIDS is a disabling or life-threatening illness caused by human immunodeficiency virus (HIV) characterized by HIV encephalopathy, HIV wasting syndrome, or certain diseases due to immunodeficiency in a person with laboratory evidence for HIV infection or without certain other causes of immunodeficiency." Some diseases that providers specifically look for to help support the diagnosis of AIDS include chronic herpes, *Candida* in the mouth and esophagus, disseminated cryptococcosis, *Toxoplasma gondii* encephalitis, CMV (*Cytomaglovirus*) retinitis, *Pneumocystis carinii* pneumonia, Kaposi's sarcoma, and tuberculosis.

### ***Diagnostic techniques***

The Air Force currently uses two laboratory tests to confirm exposure to the HIV virus, the ELISA and the Western blot test. Both tests detect HIV antibodies, but the Western blot is more specific. Neither test can detect the virus itself. These tests are highly sensitive when used for testing high-risk groups such as homosexuals and intravenous drug users, but less predictive for low-risk groups. If the ELISA test is positive on a blood sample, the sample is then tested with a Western blot test.

### ***Incubation period***

The incubation period of AIDS may range from 4 to 15 years, with an average of 8 years. The target of the virus is the CD<sub>4</sub> receptor cell, which is a type of white blood cell involved in immune system function. The triggering mechanism that starts the breakdown of the defense system has not been identified. Once infected, the patient may be asymptomatic or proceed directly to the full syndrome of AIDS.

### ***Preventive measures***

Education is the key factor in preventing the spread of AIDS. People must be educated about safe sex and the dangers associated with intravenous drug use. Avoiding the exchange of body fluids is a very effective means of preventing AIDS.

Other methods include the correct use of latex condoms from the start to finish of each sexual act. The condom, when used properly, provides the best protection for people who do not maintain a mutually monogamous relationship with an uninfected partner. Some spermicides may also offer some protection against the virus when used in conjunction with a condom.

CDC, in conjunction with the Public Health Service, offers free information about preventing AIDS to anyone who wants it. Since our knowledge of the disease is ever-changing, you can obtain current disease information from the Centers for Disease Control in Atlanta, Georgia, or from your local or state public health departments.

## **216. Managing STD patients**

In order for the prevention and control program to work effectively, people must seek medical attention. The provider must suspect a STD and order proper tests, the results must be reported, the patient must be properly treated, and all contacts must be identified and treated. This program is very involved and complicated. Public Health briefs providers on the incidence of STDs in the area and how to report all cases to PH.

Not all diseases must be reported to the local, state, or Federal governments. Follow local, state, and Air Force policy when reporting STDs. For Air Force reporting requirements we use the ASIMS AFRESS (Epi) module to track and report to the Air Force Institute for Environmental, Safety & Occupational Health Risk Analysis's Force Health Protection & Surveillance Branch monthly basis.

PH must ensure the patient has been treated and a follow-up test performed to ensure effective treatment. Our job also includes interviewing, investigating, and contacting those who had sexual contact with the patient during the period of communicability. These contacts must be identified, notified, and treated to interrupt the spread of an STD.

### **STD interviews**

Once the provider has notified the patient of the diagnosis, the patient should be referred to PH for an interview. This interview is extremely important and necessary, and it has several purposes. During these interviews, you have an important role in breaking this chain of infection in the community and controlling the spread of disease through your efforts in educating the patient. Another purpose of interviewing is to ensure that all patients and contacts are effectively treated so that complications are prevented. You also gather information that epidemiologists use to find cures and prevention techniques for the different STDs. All of the information given to patients and taken from patients must be factual and accurate in order for the control program to work.

### ***Basic elements***

Just like a lesson plan, the interview is divided into three parts. First is the introduction where you establish rapport, assess the patient's knowledge, and build the patient's confidence. During the body of the interview, you educate the patient about the disease, treatment, complications, and follow-up. You should also gather information about contacts and explain the importance of treating contacts. During the conclusion, summarize what was talked about, the importance of contact notification and treatment and the follow-up appointment. The key to a successful interview is two-fold. First, the interviewer must be knowledgeable, and secondly, the interviewer must control the conversation. Patients may try to manipulate the interviewer and control the conversation, releasing only certain information. To gain full confidence and encourage the patient to "tell all", the interviewer must be prepared.

### ***Privacy***

To conduct a successful interview, a private room must be available. Patients are more likely to give you intimate information if privacy is assured. It would be unprofessional for medical personnel to be discussing STDs and sexual contacts with a patient in a less than private room. This room should have a telephone, diagrams, references, pictures, forms, worksheets, a calendar, maps, phone book, and tissues. If these items are on hand, there is less chance for interruptions.

### ***Interviewer's knowledge of the disease***

Another step in being prepared is to be very knowledgeable about the patient's disease. You are considered to be the expert, and the patient needs to have confidence that you know what you are talking about. At a minimum, you should know how the disease is transmitted, the incubation period, the signs and symptoms, the treatment, and complications of the disease.

It usually takes time to prepare for the STD interviews. You should be thoroughly trained in STDs prior to performing your first STD interview. You may want to use an interview checklist that outlines specific information needed as you go through an interview session.

### ***Establishing patient confidence***

During the introduction, try to establish rapport and assure the patient that you are there to help. Try to get the patient to relax and be as comfortable as possible. You must exhibit a good attitude, be sympathetic, and nonjudgmental; and above all else, you must be professional. These characteristics will build the patient's confidence in your abilities.

### ***Educating the patient about the disease***

During the introduction portion of your interview, you must determine the patient's knowledge of the disease and its treatment. This may be the patient's first STD. On the other hand, this may be the patient's third time. In either case, find out what the patient knows and adjust the education portion of the interview accordingly. Explain how the disease is transmitted, symptoms usually associated with the disease, the course of treatment the provider has prescribed, and most importantly, how to prevent reinfection when the patient resumes sexual activity. Answer patient questions, obtaining assistance if necessary, and ensure the patient is sufficiently educated to prevent further spread of the disease. Stress the importance of the follow-up visit and the test of cure (if necessary).

### ***Contacting, notifying, and educating the patients' sexual contacts***

The next step in the interview is to identify all sexual contacts of the patient from the beginning of the incubation period to the present. Explain the importance of treating all partners and stress that PH is concerned only about the health and well-being of the persons involved. Some patients may not want to identify their sexual partners, and elect to notify their partners themselves. They may also give you false information. You must assume all contact information is true and attempt to notify contacts yourself or through the health department. Every contact deserves to be notified and treated if necessary.

### ***Educating the patient regarding preventive measures***

At the conclusion of the interview, preventive measures should be explained in detail. It is important to stress the use of condoms as the most effective method of preventing sexually transmitted diseases among sexually active people. It may be necessary to have a condom available to show the patient. Other preventive measures include decreasing the number of sexual partners; checking partners for signs of disease; maintaining personal hygiene, especially after sexual contact; urinating after sexual contact (vagina/penis contact); knowing the partners and where/how to get in touch with them; getting regular medical checkups; and using jellies, foams, and spermicides that offer some protection against infection.

### ***Air Force policy on STDs***

AFI 48-105, *Control of Communicable Diseases*, AFI 48-106, *Prevention and Control of Sexually Transmitted Diseases*, *STD Treatment Guidelines*, and *Control of Communicable Diseases in Man* are references you should have on hand to conduct the STD control program.

### ***Support***

AFI 48-106 explains the responsibilities of conducting an STD program. It will be important to receive the support from both your base commander and MTF commander in managing the program. Sometimes, providers do not report all cases of STDs and do not refer STD patients to PH. The MTF commander may need to educate the professional staff on the local STD policy and Air Force policy. The base commander may choose to place a local establishment off limits because of its known connection with prostitution.

**Consultation**

Due to your experience with STD patients, healthcare providers may consult with you prior to making a diagnosis. However, you must keep in mind that PH personnel are not qualified to make a diagnosis, and it is illegal for you to do so.

**Documentation and reporting**

The patient's diagnosis is documented on an SF 600, Health Record – Chronological Record of Medical Care, by the provider. And, when a patient is diagnosed with syphilis, a SF 602, Health Record – Syphilis Record, is completed by a provider and placed in the patient's outpatient medical record. (You will learn about the format for medical entries on these forms later in this volume.)

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**Self-Test Questions**

After you complete these questions, you may check your answers at the end of the unit.

**211. Syphilis**

1. What are the three different stages of acute syphilis?
2. What is the causative agent for syphilis?
3. What is the *average* incubation time for syphilis?
4. What is the most effective method used to identify syphilis in the primary stage?
5. What is the most effective nontreponemal serological test?
6. What does FTA-ABS stand for?

**212. Gonorrhea**

1. What agent causes gonorrhea?
2. What are the symptoms associated with uncomplicated male genital gonorrhea?
3. What is the term used to describe a gonorrheal infection of the fallopian tubes?
4. What are the symptoms of oral gonorrhea?
5. What is gonococcal septicemia?
6. Where are gram-negative diplococci found within a discharge sample in order to be defined as gonorrhea?
7. What does a physician consider when deciding on a patient's treatment for gonorrhea?
8. When should a test of cure be performed for gonorrhea patients?

**213. Chlamydia**

1. What microorganism causes chlamydia?
2. How are chlamydia organisms like viruses? Like bacteria?
3. On average, how long does the chlamydia organism take to incubate?

4. What two common conditions can infants develop from chlamydia exposure at birth?
5. What method is the *standard* test for identifying chlamydia in genital infections?
6. When should a test-of-cure culture be performed?

**214. Other common sexually transmitted diseases**

1. What body parts *usually* are affected with an infection of herpes simplex virus, type 2 (HSV2)?
2. When can the herpes virus be shed?
3. What is the *average* incubation period for herpes?
4. What are four causative agents for NGU?
5. What is the *average* incubation period for NGU?
6. What is vaginitis?
7. What are the symptoms associated with vaginitis?
8. What is Lymphogranuloma venereum (LGV)?
9. What usually happens if LGV is not treated within about 30 days?

10. What are the three types (species) of lice that infect humans?

11. What three diseases may be found with lice infestations?

**215. Acquired immune deficiency syndrome (AIDS)**

1. What is the cause of AIDS?

2. HIV kills which cells in the immune response system?

3. How can AIDS be transmitted?

4. What are the AIDS risk groups?

5. What are the two diagnostic tests the Air Force uses to diagnose AIDS?

6. What is the *average* incubation period for AIDS?

7. What is the best method of protection against AIDS for people who do not maintain a mutually monogamous sexual relationship?

**216. Managing STD patients**

1. What are two purposes of an STD interview?

2. What are two keys to a successful interview?

3. What supplies are recommended for an interview room?

## 2-3. Hepatitis and Enteric Diseases

Hepatitis is another important disease that has many variations and serious consequences. It is a disease that is often misunderstood. A great deal has been learned about hepatitis in the past 20 to 30 years, and researchers continue to learn more about the viruses that cause hepatitis. It is important for you to keep up with the most current information about this disease.

### 217. Types of hepatitis

Hepatitis is an inflammation of the liver that may be caused by bacteria, viruses, protozoa, helminths, chemicals, or drugs. In this section, you will study the different viruses that cause hepatitis. There are many types of viral hepatitis. Two primary forms you may be familiar with are hepatitis A and hepatitis B. However, there are other forms of hepatitis that may resemble or mimic these two. Hepatitis C, D, and E are newer forms, each type will be discussed individually.

#### Hepatitis A

Hepatitis A is usually a mild disease lasting 1 to 2 weeks, but it can be debilitating and last for several months. The symptoms include fever, malaise, anorexia, nausea, and abdominal discomfort, followed within a few days by jaundice. Children under 2 years of age usually are asymptomatic; children above 2 years of age are more likely to have symptoms. The disease is transmitted by the fecal-oral route. The incubation period is 15 to 50 days, with an average of 28 to 30 days. The infected individual usually sheds the virus in the feces during the last half of the incubation period; and the virus usually disappears from the feces within a week after the onset of symptoms.

#### *As a common problem*

Hepatitis A is a common problem in child development centers because of the poor hygiene of young children and because 90 percent of infected children are asymptomatic. This is why diapered and toilet-trained children are separated in child development centers. Also, it can be a problem for the military members, who are assigned or deployed to an area of endemic disease. This virus is transmitted through contaminated food and water (including milk, sliced meats, salads, and raw or undercooked mollusks) and by direct contact.

#### *Diagnosis*

Hepatitis A is diagnosed by hepatitis A virus (HAV) antibodies in the serum of acutely or recently ill patients. The ELISA (enzyme-linked immunosorbant assay, also known as enzyme immunoassay or EIA) or the RIA (radioimmunoassay) test is used to assist with the diagnosis of hepatitis A. At the present time, it is not possible to identify the HAV antigen.

#### Hepatitis B

The effects of hepatitis B can be more severe than hepatitis A. Symptoms include anorexia, vague abdominal discomfort, nausea, and vomiting. Sometimes a rash is present. Ultimately jaundice develops. Fever is usually either mild or absent. Hepatitis B virus may infrequently result in chronic infection in carriers, chronic active hepatitis, and cirrhosis of the liver. It is the primary cause of hepatocellular carcinoma, a form of liver cancer.

#### *Body fluids*

Although the hepatitis B virus (HBV) has been found in all body fluids, such as blood, saliva, and semen, only the blood- or serum-derived fluids are known to be infectious. Contaminated needles, syringes, and other intravenous equipment are important vehicles for transmitting the disease, especially among intravenous drug users. The infection may be spread through contamination of wounds or lacerations, or by exposure of mucous membranes to infective blood, which is an important source of transmission in healthcare occupations. The virus is also transmitted through sexual contact.

***Incubation***

Hepatitis B incubates for about 45 to 180 days, with an average of 60 to 90 days. However, the HBV antigen can be found as early as 2 weeks after exposure. Usually, the individual becomes infective within a month or two after exposure.

***Diagnosis***

Either the EIA test or the RIA test is used to diagnose HBV. In a hepatitis B panel, the markers measured for hepatitis B are surface antigen and antibody, core antigen and antibody, and e antigen and antibody. The diagnosis is confirmed by finding hepatitis B surface antigen, or recent development of antibody to core and/or surface antigens.

**Hepatitis C**

Hepatitis C is similar to Hepatitis B with symptoms of anorexia, vague abdominal discomfort, nausea, and vomiting; however, jaundice occurs less frequently. Severity ranges from unnoticeable to severe; fatality is rare. Transmission may occur within the body from exposure to contaminated blood and plasma derivatives, which accounts for approximately 90 percent of the cases of this disease. Many virologists refer to this hepatitis as “posttransfusion hepatitis.” However, “community acquired” cases are also important to consider, so contaminated needles and syringes are important vehicles of spread that must be controlled.

***Incubation***

The incubation period ranges from 2 weeks to 6 months; most commonly, within 6 to 9 weeks. The period of communicability is 1 or more weeks before onset of the first symptoms through the acute clinical course of the disease, and indefinite in the chronic carrier stages.

***Prevention***

Preventive measures are the general control measures against hepatitis B, as you will learn about in the next section. In blood bank operations, it is advisable to discard units from donors who have elevated liver enzymes or test positive for core antibodies.

**Hepatitis D**

This form of hepatitis seems to be caused by two viruses, the hepatitis B virus and the delta virus. Although transmissible as an independent agent, delta viruses can only infect and cause illness when hepatitis B viruses are present. Therefore, a co-infection with hepatitis B must exist for virus synthesis. During this synthesis, the hepatitis B viral components are temporarily suppressed.

Hepatitis D is transmitted like hepatitis B virus, with an estimated incubation period of 2 to 8 weeks. Onset is usually abrupt and severe, with signs and symptoms resembling those of hepatitis B infection. The RIA and ELISA tests are the methods of choice for confirming the diagnosis of delta hepatitis.

**Hepatitis E**

The course and symptoms of this form of hepatitis are similar to hepatitis A; there is no evidence of a chronic form. The fatality rate is very low, except in pregnant women where the rate may reach 20 percent during the third trimester of pregnancy. The mode of transmission is contaminated water and probably from person to person via the fecal-oral route. The incubation period is 15 to 64 days, with an average of 26 to 42 days. General preventive measures are similar for those of hepatitis A and include basic measures to prevent fecal-oral transmission, education stressing sanitary disposal of feces, and careful handwashing after defecation and before handling food.

## **218. Hepatitis prevention and control measures**

Although there are not any cures for any type of hepatitis, there are measures that individuals can take to prevent infection or the spread of hepatitis.

### **Hepatitis A**

Individuals at risk for hepatitis A can be educated about the importance of sanitation. For example, caregivers at the child development center (CDC) can be at risk of acquiring hepatitis A if they care for diapered children. Children under the age of 2 years usually do not show symptoms when infected with HAV. If handwashing and diaper changing procedures are not rigidly adhered to, it is possible to pass the infection on to other children and caregivers. You will not be aware of a problem until infected caregivers or parents become symptomatic. By the time adults show symptoms, you may have a full-scale epidemic on your hands. Therefore, it is very important for the CDC director to enforce strict sanitation and handwashing procedures at the center.

### ***Prophylaxis***

Education is not the only preventive measure you can take to protect people exposed to HAV. Individuals exposed to hepatitis A can be given an injection of hepatitis A vaccine to prevent hepatitis A infection, or to lessen their symptoms. Only close contacts, such as CDC workers exposed to infected individuals and household contacts should be given the injection as a precaution. The decision whether to administer injections is made by the provider after consulting with PH or the Infection Control Committee. However, for this type of injection to be effective, it must be administered within 2 weeks of exposure.

### ***Surveillance***

Prophylactic treatment of contacts and education of risk groups on the spread of HAV are only two of the preventive measures available. There may also be a need to conduct closer surveillance of food and water supplies.

### **Hepatitis B**

This disease is transmitted through contaminated blood products and body fluids. Risk groups must be educated about the disease and its mode of transmission. Individuals exposed to HBV should be given hepatitis B immune globulin (HBIG) within 1 week of exposure.

Since HBV is transmitted through body fluids, people such as healthcare providers, laboratory and bloodbank workers, and dental personnel are at risk for occupational exposure to HBV. Examples of exposures might be from needle sticks or exposure to an infected patient's mucous membranes.

There is an effective vaccine to prevent HBV infection. The vaccine is a series of three injections, given over 6 months, with the follow-up injections given at 1 month and 6 months after the initial injection. Vaccination of military members at high risk for occupational exposure to hepatitis B virus is now mandatory.

### ***Prevention***

Preventive measures for the other forms of hepatitis are the same as, or similar to, those used for hepatitis A and B. Education and sanitary controls are the keys to effectively controlling and preventing the spread of viral hepatitis.

### ***Sanitation***

Equipment, such as surgical instruments, that come into contact with body fluids must be completely sanitized to preclude the transmission of the disease. Procedures for handling body fluids, such as blood, saliva, and semen, must be evaluated carefully.

### **Prophylaxis**

The Centers for Disease Control (CDC) has published guidelines on *pre-* and *post-*exposure prophylaxis for exposure to all types of hepatitis.

## **219. Common enteric diseases**

The term *enteric* means *having to do with the intestinal tract*. Because of time and space constraints, you will learn about only a few of the most common enteric diseases in this lesson.

### **Cholera**

Cholera is an acute disease with sudden onset of profuse watery stools, occasional vomiting, rapid dehydration, and circulatory collapse. Without prompt treatment, almost half of the severe cases will die; with prompt treatment, only a few may die. The infectious agent is the bacteria *Vibrio cholerae*, which includes several subgroups. The bacteria are transmitted through water that has been contaminated with feces or vomitus of patients or carriers. They also can be transmitted by individuals' consumption of food that was contaminated with dirty water, feces, soiled hands, or flies. Contaminated or undercooked seafood also can pass the bacteria to humans. The incubation period is from 2 to 5 hours, up to an average of 2 to 3 days.

Diagnosis is confirmed by culturing cholera from the fecal material of suspected patients. The diagnosis can be performed with the assistance of dark field or phase microscopy examination of the motility of the bacteria as well as by noticing a rise in the individual's titer of antitoxic antibodies through serological testing (providing vaccine was not given). Asymptomatic infections are much more common than clinical illness. Vaccination, although available, is not as effective or practical as sanitation in controlling the disease.

### **Amebiasis**

Amebiasis is frequently referred to as "amebic dysentery." The causative organism is *Entamoeba histolytica*, a protozoan parasite. Infected individuals may show symptoms ranging from dysentery (inflammation and ulceration of lower bowels with diarrhea that becomes mucoid and hemorrhagic) with fever and chills, to mild abdominal discomfort with bloody or mucoid diarrhea alternating with periods of constipation and remission. In epidemics, amebiasis is transmitted mainly through drinking water that has been contaminated with the protozoa. Endemically, it may be spread by vegetables fertilized with "night soil" (or human feces), flies, and water. Amebiasis may also be transmitted by homosexuals engaging in oral-anal intercourse. The incubation period for this disease is from a few days up to several years, with an average of 2 to 4 weeks.

The control measures for amebiasis include selecting water sources that are not contaminated with feces, educating the population, and proper water treatment. Water must be either boiled or filtered with a diatomaceous earth (earth composed mostly of algae fossil remains) filter.

### **Giardiasis**

This disease occurs worldwide, and affects children more often than adults. Outbreaks are common in child development centers. These outbreaks occur because of the poor personal hygiene of children or lack of proper hygiene and sanitation by caregivers. The infectious agent is the protozoa *Giardia lamblia*, which is transmitted as a cyst by fecally contaminated water, or by person-to-person contact in institutions or day care centers. Asymptomatic carriers play an important part in the transmission of this disease. Symptoms include chronic diarrhea, abdominal cramps, bloating, frequent loose and pale greasy stools, fatigue, and weight loss. Illness normally occurs 3 to 25 days after exposure, with an average of 7 to 10 days.

***Safe drinking water***

Outbreaks are common in communities that do not filter the water. Unfiltered streams or lakes may be contaminated with human feces. Even though most U.S. communities have modern sewage treatment systems, the chlorine concentrations used in routine water treatment plants do not kill *Giardia* cysts. Under emergency conditions, to make water contaminated with cysts safe for drinking, it must be superchlorinated with at least 5 parts per million (ppm) chlorine residual, or boiled, or filtered with diatomaceous earth.

***Epidemiology***

Epidemiology is important in controlling the spread of giardiasis. Household members and other suspected contacts should have fecal exams for the cysts. Proper selection of water sources and education of the families, personnel, and patients of institutions, especially child development centers, are important in preventing an outbreak of giardiasis.

***Shigellosis***

Shigellosis, sometimes called bacillary dysentery, is an acute bacterial disease involving the large intestine. Symptoms include diarrhea, fever, nausea, vomiting, cramps, and sometimes convulsions in children. Typically, the stools contain blood, mucous, and pus. Four species of *Shigella* cause this disease.

***Mode of transmission***

The mode of transmission of *Shigella* is fecal-oral; the incubation time is from 1 to 7 days, with an average of 3 days. The disease may last a week or more, with the average being 4 to 7 days. A person is considered infectious as long as the organism is found in the feces. The *Shigella* organism is very susceptible to environmental changes, such as heat, cold, and disinfectants; and therefore, outbreaks of shigellosis do not occur as frequently as outbreaks of giardiasis. Outbreaks are common under conditions of overcrowding and poor sanitation, such as institutions for children (CDC), crowded camps, and mental hospitals.

***Prevention and control***

The prevention and control for shigellosis involves proper sewage disposal, proper selection and treatment of water, and proper handwashing. Infected people should not be employed as foodhandlers or caregivers in CDCs.

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**Self-Test Questions**

**After you complete these questions, you may check your answers at the end of the unit.**

**217. Types of hepatitis**

1. What is the incubation period for hepatitis A?
2. How can hepatitis A be transmitted?

3. Which is more severe, hepatitis A or hepatitis B?
4. What is the incubation period for hepatitis B?
5. What two tests are used to diagnose hepatitis B?
6. What disease coexists with an infection of hepatitis D?

**218. Hepatitis prevention and control measures**

1. What are the two types of preventive treatment for hepatitis A?
2. What can people who have been exposed to Hepatitis A be injected with as a prophylaxis measure?
3. What is the prophylaxis for people exposed to hepatitis B?
4. What can laboratory workers, healthcare workers, and bloodbank workers take to prevent hepatitis B infection?

**219. Common enteric diseases**

1. What is cholera?
2. What is the incubation period for cholera?
3. How is amebiasis transmitted during an epidemic?

4. What are three control measures for amebiasis?
5. What are the symptoms of giardiasis?
6. How soon after exposure does giardiasis occur?
7. What is shigellosis?
8. What is the mode of transmission for shigella?

## **2-4. Communicable Disease Reporting and Infection Control**

You have learned about many diseases in this volume. What good is this information to you? The foundation of your job is *prevention*. And to be good at your job, you must know the specifics about a disease before you can educate people on preventing the disease. You also need to know if there is an increase of disease incidence in your local community, and you need to be able to track this information to project a possible increase at your MTF. PH reports to the medical staff the disease rates in the local area. This helps the healthcare providers look at the local picture of disease problems. You also have a part in making the “big picture” for the Air Force by reporting disease incidences to higher headquarters.

### **220. Communicable disease reporting**

As part of an active communicable disease surveillance system, many diseases require immediate reporting. In some cases, even a *suspected* diagnosis should be reported as soon as possible to avoid delays in epidemiologic follow-up while waiting for laboratory confirmation. Examples of diseases requiring rapid case reporting include universal reporting of diseases identified by International Health Regulations, such as cholera, yellow fever, plague, measles, and meningitis.

#### **USAF reportable diseases**

It is the responsibility of PH to find out which diseases are to be reported under federal, state, and local laws, and to prepare a list of these diseases. AFI 48-105 lists the communicable diseases that USAF MTF’s must report to higher headquarters (fig. 2-4). See AFI 48-105 for the complete listing of all diseases that require reporting.

**Table 1. Communicable Disease Requiring Electronic Report within 24 Hours.**

Anthrax	Meningitis
Botulism	Leptospirosis
Botulism, (Infant)	Listeriosis
Cholera	Plague
Deugue Fever	Polimyelitis
Diphtheria	Rabies
E Coli 0:157 infection	Reye's Disease
Encephalitis	Rheumatic Fever
Unspecified	Rubella (congenital)
Pertussis	Small pox
Guillian-Barre syndrome	Tetanus
Haemophilus influenza, invasive	Tularemia
Legionellosis	Typhoid Fever
Hansen's disease	Typhus (all)
Malaria	Yellow Fever
Measles	
Meningitis	
Unspecified	
Aseptic	
Bacterial	

**Table 2. Communicable Diseases Requiring Monthly Report.**

Amebiasis	Human Immunodeficiency Virus
Brucellosis	Lyme disease
Campylobacteriosis	Mumps
Coccidiomycosis	Psittacosis
Diarrhea outbreaks	Relapsing Fever
Food-associated illness	Rocky Mountain Spotted Fever
Giardiasis	Salmonellosis
Hepatitis, viral	Shigellosis
Unspecified	Toxic Shock Syndrome
A	Trichinosis
B	
C	
Delta	
E	
Non-A, Non-B	

**Figure 2-4. AFI 48-105 tables of reportable diseases.**

**Reporting procedures**

PH is responsible for making communicable disease reports to civilian agencies. Anytime these reports may adversely impact security or security regulations, the civilian authorities are bypassed and the report is sent to the next higher Air Force headquarters for action.

***When a listed disease is diagnosed***

You need to be informed each time a listed disease is diagnosed. This notification includes outpatients, inpatients with suspected or confirmed diseases upon admission, a diagnosis that changes during hospitalization, or diseases that are first reported at the time the patient is discharged. The provider must notify PH so that communicable diseases can be properly investigated and reported.

***Keep your list up-to-date***

PH has the responsibility of assuring a copy of the list of reportable diseases is sent to each healthcare provider, and that they are aware of the reporting procedures. Your procedures and forms should be adapted to meet the reporting requirements of the local and state health departments, as well as Air Force requirements. Update your list of reportable diseases as necessary, but at least annually.

***Action by healthcare providers***

A healthcare provider making a suspected or confirmed diagnosis of any condition on the list reports the case to PH immediately using the telephone; AF Form 570, Notification of Patient's Medical Status; or a form devised locally for this purpose (fig. 2-5). This report may be prepared by support personnel if the diagnosis is entered into the health record.

PH is required to use the AF Form 570 to report to the dental clinic.

NOTIFICATION OF PATIENT'S MEDICAL STATUS											
IDENTIFICATION											
NAME OF PATIENT, GRADE, SSAN <i>Mattson, Tim TSgt</i> <i>000 - 11 - 2222</i>				DATE <i>2 Aug 95</i>		HOUR <i>0730</i>					
				INPATIENT UNIT		REGISTER NO.					
				SERVICE		PHYSICIAN					
II. REASON FOR REPORT											
<input checked="" type="checkbox"/> COMMUNICABLE DISEASE				<input type="checkbox"/> VERY SERIOUS ILL PATIENT							
<input type="checkbox"/> INJURY INCURRED AFTER ADMISSION				<input type="checkbox"/> SERIOUSLY ILL PATIENT							
<input type="checkbox"/> ANTICIPATED MEDICAL BOARD / PHYSICAL EVALUATION BOARD ACTION				<input type="checkbox"/> INCAPACITATING ILLNESS OR INJURY							
<input type="checkbox"/> PROLONGED HOSPITALIZATION (90 days or longer)				<input type="checkbox"/> REMOVE PATIENT FROM VERY SERIOUSLY ILL, SERIOUSLY ILL OR INCAPACITATING ILLNESS OR INJURY LISTS							
<input type="checkbox"/> DEATH				<input type="checkbox"/> REQUEST MEDICAL RECORDS							
				<input type="checkbox"/> OTHER (Specify in remarks)							
III. DIAGNOSIS <i>Hepatitis B</i>											
PROGNOSIS / NEXT OF KIN DATA											
RECOVERY IS			<input checked="" type="checkbox"/> EXPECTED		<input type="checkbox"/> NOT EXPECTED		<input type="checkbox"/> NOT ASSURED, FURTHER OBSERVATION NECESSARY				
PRESENCE OF RELATIVES DESIRED			<input checked="" type="checkbox"/> NEXT OF KIN IS AT BEDSIDE		<input type="checkbox"/> ORGAN DONOR SITUATION						
CLEARANCE BY CHIEF OF SERVICE			<input type="checkbox"/> NEXT OF KIN HAS BEEN NOTIFIED								
DATE <i>2 Aug 95</i>			NAME OF PHYSICIAN <i>J.B. Physician</i>				SIGNATURE <i>J.B. Physician</i>				
ACTION BY PATIENT AFFAIRS / ADMINISTRATIVE OFFICER OF THE DAY ON VERY SERIOUSLY ILL, SERIOUSLY ILL, INCAPACITATING ILLNESS OR INJURY, AND DEATH CASES											
ACTION		DATE		HOUR		ACTION		DATE		HOUR	
REPORTED RECEIVED						HOSPITAL PERSONNEL NOTIFIED (Specify below)					
BASE PERSONNEL RESPONSIBLE FOR CASUALTY NOTIFICATION ADVISED											
OTHER BASE PERSONNEL NOTIFIED (Specify below)											
REMARKS											
DATE				NAME OF PATIENT AFFAIRS / ADMINISTRATIVE OFFICER OF THE DAY				SIGNATURE			

AF FORM 570 AUG 80 PREVIOUS EDITION WILL BE USED

Figure 2-5. Sample, AF Form 570.

***Dental clinic notification***

As a PH journeyman, you will also use AF Form 570 to report to the dental clinic any diagnosis of a communicable disease that could be spread through dental treatment. Be sure to estimate the period of communicability for each disease diagnosis.

**221. Infection control in medical treatment facilities**

Medical treatment facilities (MTF) are hazardous. A century ago, very little was known about the cause and spread of infectious diseases. Sometimes even if the patient survived (a rarity), the hospital staff associated with the patient's care would develop the disease. Pyogenic (or pus-producing) infections were thought to demonstrate a proper body reaction to injuries since they routinely occurred from minor as well as major surgery or medical treatment. Little attention was paid to proper ventilation and there were not any effective cleaning and disinfecting agents for personal and environmental sanitation. It was not until much later that effective techniques were developed for disinfection and sterilization.

**PH responsibilities**

Your primary responsibilities as a public health journeyman in the area of infection control are surveying, investigating, and reporting communicable diseases; and monitoring the employee health program.

***Surveying, investigating, and reporting***

Surveying and investigating communicable diseases among hospital personnel and patients, and reporting to the Infection Control Committee are your primary duties. PH identifies disease trends and maintains accurate communicable disease statistics that are essential to accomplishing this task.

***Monitoring the employee health program***

Monitoring the employee health program is the other part of your duties. This "monitoring" consists of making recommendations to the MTF Infection Control Committee for laboratory tests or immunizations necessary for preemployment and routine physicals. For example, you would recommend that a nurse with active oral herpes not work in the newborn nursery because of the potential for transmission of this virus to the infants.

The employee health program also includes detecting disease outbreaks within the medical treatment facility or identifying people who require duty limitations because of a permanent or temporary medical condition, such as pregnancy. CDC has issued guidelines on the restriction of hospital personnel with specific infections.

**Major causative organisms**

Antiseptics, antibiotic drugs, and sterile techniques have greatly reduced the risk of wound infections. However, the development of antibiotic-resistant strains of organisms pose an additional problem.

***Hospital-acquired infections***

Gram-negative aerobic bacilli, such as *Klebsiella*, *E. Coli*, *Alcaligenes*, *Proteus*, and *Pseudomonas* organisms, have been identified most frequently as the causative agents of hospital-acquired (nosocomial) infections. Infection control procedures are meant to minimize nosocomial infections.

***Increased susceptibility***

Certain factors may increase a patient's susceptibility to infection. Among these are physical debility, chronic disease, leukemia, other cancers, extreme youth or age, bed sores, and other open wounds or breaks in the skin.

**Infection transmission in the hospital**

Disease transmission in the hospital is studied by looking at the types of infections that develop. There are two basic types of infection, endogenous and exogenous. Endogenous infections develop from organisms the patient normally carries. Due to poor personal hygiene, pathogenic organisms are transferred from one site to another site on the same patient such as from skin to abdominal cavity. Exogenous infection results from pathogens being transferred from the hospital environment to personnel or equipment to the patient.

***Three sources of infection***

There are three basic sources of exogenous infection.

***First source***

The first source is structural inadequacies, such as inadequate air-conditioning systems that recirculate unfiltered air or old water distribution systems. These situations provide both air and water reservoirs with a real potential to become contaminated. Overcrowding within the facility, as well as improper placement of fixed equipment, such as sinks, may also be major contributing factors in the transmission of infection. Overcrowding allows infections to be transmitted more easily, and inadequate or improper placement of sinks prevents hospital personnel from washing their hands as frequently as they should between patients or after handling equipment contaminated with body fluids.

***Second source***

The second source is contaminated devices or equipment used in the hospital environment. The equipment or devices used within the medical facility may also be sources of infection. Complicated, highly sophisticated, and expensive equipment that is difficult to dismantle can lead to disinfection and sterilization problems. It may be too fragile to allow for thorough disinfection or sterilization, or the equipment may be cleaned or disinfected with an inappropriate agent. The infection control officer should ensure that there are procedures established for the proper cleaning and disinfection or sterilization of equipment, while the central supply maintains the cleaning and sterilization of the hospital supplies and equipment.

***Third source***

The practices employed by medical staff or other patients within the hospital is the third source of exogenous infection. Failure of employees to wash their hands, adequately or often enough, is the most frequent cause of exogenous infection. Infectious material is conveyed from the medical staff to patients primarily by their hands. Frequent and thorough handwashing is the most effective way to break this mode of transmission. Gloves should be used in high risk areas such as in the new born nursery or when invasive procedures like surgery are performed. Personnel should still wash their hands before and after patient contact, even if gloves are used.

**Medical treatment facility infection control responsibilities**

The hospital is a unique “industrial shop.” AFI 48-101, *Aerospace Medical Operations*, identifies one of PH’s responsibilities as evaluating and monitoring the occupational and public health of all Air Force personnel. PH integrates and supports all preventive medicine and occupational health programs of the Aeromedical Council and Infection Control Committee.

***Supporting infection control committee***

One avenue of monitoring the occupational environment in the hospital is the Hospital Infection Control Committee, of which the PHO is a member. This committee's major mission is to control and prevent the occurrence of nosocomial infections within the hospital environment. This is done by characterizing the nature and extent of nosocomial infections through disease surveillance and establishing practical, effective hospital policies for infection control. The committee advises the MTF Commander concerning matters pertaining to infections. This involves instituting studies to determine sources of infectious agents, determining infection control policies and procedures, and imposing control measures to prevent the spread of nosocomial infections. At most bases the infection control officer (ICO) has the major input to this committee.

***Supporting the infection control officer***

The role of the ICO is to reinforce the importance of infection control measures, provide for early identification of outbreaks within the MTF, provide informal in-service education concerning infection control, and provide new information in the area of nosocomial infection control.

***General infection control practices***

To prevent the spread of infection, all personnel in the MTF must work together to ensure that good infection control procedures are followed. The Infection Control Committee and the Infection Control Officer review these procedures and make appropriate recommendations to correct deficiencies. Medical treatment environmental sanitation practices should very closely parallel those of other areas. However, there are several practices that are unique to the hospital environment.

Practices	Description
<b><i>Proper communication</i></b>	The ICO or attending physician must ensure proper communication between hospitals to prevent transfer of infections from one hospital to another.
<b><i>Control use of antibiotics</i></b>	The ICO or attending physician also prevents indiscriminate use of antibiotics to decrease the probability of new resistant strains of pathogens evolving.
<b><i>Control infected personnel</i></b>	The ICO or section supervisors must control infected hospital personnel's contact with patients.
<b><i>Restrict access</i></b>	The ICO and nurses must restrict access to high risk areas such as new born nurseries, delivery rooms, operating rooms, and OB and surgery wards.
<b><i>Comply with hygiene procedures</i></b>	The ICO must demand strict compliance with personal hygiene procedures from all hospital personnel.
<b><i>Disinfect and sterilize supplies</i></b>	Central Supply maintains the proper disinfection and sterilization of hospital supplies.
<b><i>Dispose of waste</i></b>	The ICO and BEE ensure infectious hospital waste is properly disposed.
<b><i>Control pesticides</i></b>	The BEE, CE, and PH should coordinate on all recommendations for pesticide use and vector control methods.

***Established procedures***

These practices are necessary, as are proper design of the facility and equipment, adequate space requirements, and dust control. For this reason practices such as dry sweeping are prohibited, and contaminated linens and blankets are not shaken or mixed with other laundry. There must also be established procedures for the handling of clean and soiled linens. This includes separate storage areas to prevent cross contamination. Contaminated trucks must not transport clean laundry. Clean laundry should be transported in a clean truck. As you can see, these practices take a team effort of many MTF personnel. Infection control will not succeed without the team effort. These practices are just a few of the steps the team takes to prevent and control the spread of hospital infections.

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**Self-Test Questions**

**After you complete these questions, you may check your answers at the end of the unit.**

**220. Communicable disease reporting**

1. Reportable disease lists should be updated in accordance with what directive?
2. Who ensures civilian agencies are notified of reportable diseases?
3. How does a physician notify PH of a reportable disease?
4. How does PH notify the dental clinic of a communicable disease?

**221. Infection control in medical treatment facilities**

1. What does “monitoring” the employee health program consist of?
2. What organisms have been identified most frequently as the causative agents of hospital acquired infections?
3. What is an *endogenous* infection?

4. What are the three sources of *exogenous* infections?
5. What is the Hospital Infection Control Committee's primary mission?

## 2-5. Foodborne Illnesses

The last category of diseases in this unit is not new to our career field and is directly linked to another part of our job—sanitation of food facilities. First, you will study the diseases and then you will learn how to investigate them during an outbreak.

### 222. Common foodborne illnesses

This segment will explain the causes, signs and symptoms, and preventive measures of foodborne illness. Of course, preventing a foodborne illness is our ultimate goal. Foodborne illnesses are of two general categories, infections and intoxications.

#### Foodborne infections

These illnesses are caused by ingesting food or drink containing pathogenic organisms (viruses, bacteria, protozoa, and various parasites). The delayed onset of symptoms suggests the growth of organisms after ingestion, and, therefore, the illness is not necessarily related to the amount of offending food ingested.

#### *Salmonellosis*

One of the more common foodborne infections that might adversely affect the mission at your base is salmonellosis. More than 1,700 serotypes of *Salmonellae* exist, and *Salmonella* organisms cause a high percentage of foodborne infections. *Salmonella* infections are common in animals, especially birds. Therefore, infection may result from eating improperly prepared, preserved, or cooked poultry and meats. Ground meat and sausage are especially vulnerable due to the amount of processing and possibility of cross-contamination. Outbreaks can result from cross contamination between contaminated foods, such as poultry, to uncontaminated, ready to eat foods. Foodhandlers are usually responsible for this cross-contamination via their hands, utensils, or food contact surfaces. Specific circumstances permit the transmission of salmonellosis. These circumstances include contamination of food capable of supporting growth of *Salmonella* such as poultry, favorable temperatures 40 to 115°F, and sufficient time for organisms to multiply to a dangerous level, about four hours.

#### *Symptoms*

Symptoms of *Salmonella* infection occur between 6 and 72 hours after ingestion, with an average of 12 to 36 hours. The symptoms vary from nausea to severe headache, chills, fever, violent retching, colic, and diarrhea. Recovery may take from 1 to 3 days up to a week. Death is rare and usually occurs mainly in highly susceptible groups such as young children, the elderly, and those with compromised immune systems.

#### *Control measures*

Control measures are similar to those involving other foodborne illnesses and include chilling foods rapidly; cooking foods thoroughly; maintaining cleanliness of food, foodhandlers, and equipment; restricting sick employees from foodhandling duties; ensuring proper handling of foods, and adequate storage, especially adequate refrigerated storage; using pasteurized dairy and egg products; using eggs whose shells have not been cracked; and sanitizing equipment.

### ***Streptococcal infections***

The causative circumstances surrounding a streptococcal foodborne infection generally parallel to those of a *Salmonella* outbreak. The incidence of streptococcal foodborne infection is less and the symptoms are milder than those of salmonellosis.

#### ***Symptoms***

Symptoms may begin 1 to 3 days after ingestion of infective food and often include red sore throat, high fever, and vomiting. The infectious agent is *Streptococcus pyogenes* which causes sore throats and scarlet fever, and may be transmitted to food through droplet infection (spread by talking, coughing, and sneezing) or direct contact such as with foodhandler's hands. Susceptible foods include poultry and eggs, potato salad, meat dishes, and low-acid foods.

#### ***Control measures***

Control measures include chilling foods rapidly; cooking foods thoroughly; practicing good personal hygiene; using pasteurized milk products; and excluding workers from handling foods if suffering from respiratory illness or infected skin lesions.

### ***Hepatitis A***

You have already learned about HAV and can refer to the sections on hepatitis earlier in the volume. Because of the long incubation period, it is very difficult to identify the source of the virus when investigating an outbreak. Control and epidemiological investigation center around possible transmission by food or water. Special efforts should be made to improve sanitation and personal hygiene. Reduction of fecal contamination of foods and water should be stressed. It's important to remove any infected foodhandler from the kitchen until their infections are resolved.

### ***Campylobacter jejuni***

*C. jejuni* is a common inhabitant of the intestinal tract of cattle, swine, sheep, chickens, turkeys and other animals such as dogs, cats, rodents, and monkeys. Raw or undercooked animal origin foods are the most likely source of human infection. Unchlorinated water has also been a vehicle in several major outbreaks of *C. jejuni*. The disease is known as campylobacteriosis or campylobacter enteritis and is more common than salmonellosis and shigellosis combined! In fact it is the most common bacterial pathogen associated with foodborne illnesses.

#### ***Symptoms***

The symptoms include nausea, abdominal cramps, headache, fever, and diarrhea which might be bloody if severe. The symptoms begin about 2 to 5 days after infection. Individuals remain ill for about 2 to 3 days, but illness can last up to weeks or months when complications set in. Complications include meningitis, cholecystitis, urinary tract infection, and reactive arthritis.

#### ***Control measures***

*C. jejuni* does not grow or survive well in foods. It is usually killed easily with heat, and inhibited by acid, salt, and drying. The organism will not multiply at temperatures below 85°F. In the past, this organism was not considered important because it was not identified. One of the reasons it was not identified was due to the special laboratory procedures needed to grow and identify the organism. It takes an experienced lab technician using darkfield microscopy to identify the organism. The lab needs to know if you suspect this organism as a causative agent. The darting, motile, corkscrew-shaped organisms may be easily mistaken and misidentified. Your job is to help pinpoint the cause of an outbreak. As public health officials and laboratory personnel become more aware of *C. jejuni*, the identification of this organism in foodborne illness outbreaks will probably increase. The control measures are the same as used for *Salmonella* infections.

***Listeria monocytogenes***

Infection with *Listeria monocytogenes* is known as listeriosis.

***Symptoms***

Listeriosis is frequently associated with women who are pregnant and newborn babies and often results in meningitis and prenatal septicemia. Infections can result in stillborn or acutely ill infants or can cause abortions, which usually occur in the last half of pregnancy. If infected infants survive birth, they often either die shortly after birth or develop meningitis leading to either death or permanent mental deficiency. Individuals with malignancy, cirrhosis, or other immune-deficiency conditions are also at high risk.

***Control measures***

The causative organism *Listeria monocytogenes* is widely distributed in nature and has been isolated from healthy human's milk and cow's milk. It also has been isolated from fermented silage (vegetables in storage silos that have fermented), leafy vegetables, and soil. It survives longer in sewage and sludge than *Salmonella*. The organism is sensitive to heat and is destroyed during pasteurization, but if it survives these processes, it is capable of growth under refrigeration temperatures.

*L. monocytogenes*'s distribution in the environment, ability to survive for long periods of time under adverse conditions, and ability to grow while under refrigeration make it a potentially important cause of foodborne illness in the future. Although the dairy industry closely polices its procedures, mistakes are made and procedures bypassed, which puts raw milk into a finished product and causes *Listeria* outbreaks.

***Miscellaneous foodborne infections***

There are many other pathogens that can be transmitted through the food chain. However, they do not occur as often as those previously mentioned. Among these are numerous intestinal parasites such as pork, beef, and fish tapeworms, and other helminths; intestinal viruses; and bacterial diseases such as brucellosis.

***Symptoms***

Many of these diseases are primarily diseases of animals but are capable of infecting humans if the organisms are ingested in improperly prepared or processed foodstuffs. Undercooked meats may contain infective tapeworms or trichinae; and raw milk can be a prime source of brucellosis, diphtheria, Q-fever, or bovine tuberculosis. In most instances, veterinarians control these diseases through vaccination of herds or slaughter of infected animals if a cure is not possible or feasible. In trichinosis control, cooking of raw garbage to be used as hog food is one preventive measure. Additionally, our society has been taught over the years to cook pork until well done which assures destruction of trichinae. Veterinary meat inspection, before and after slaughter, further controls the transfer of most animal diseases.

***Control measures***

Control of the transmission, in some instances, is the best method of prevention. Pasteurization of milk is the intermediate control in brucellosis, Q-fever, and bovine tuberculosis. Pork must be thoroughly cooked to prevent trichinosis, and all other meats should be cooked adequately to control parasites. Thorough cooking of all pork products to an internal temperature of 170°F is a realistic and satisfactory positive control.

## **Foodborne intoxications**

The most common cause of foodborne intoxication are bacteria, although poisonous plants, animals, and chemical intoxication are occasionally the cause of serious outbreaks. Bacteria cause illness under the right conditions, by releasing a toxin into the food. Many of these bacteria are constantly present in healthy individuals. However, they are not a problem until the bacteria are allowed to reproduce and form a toxin in the food. This only occurs if foods are mishandled or improperly stored. Chemical intoxication can be caused by preparing or storing acidic foods in containers made of materials toxic to humans, such as a galvanized container used to hold tomatoes or fruit juice. This can also be a problem if chemicals are stored with food and inadvertently added during preparation. Some plants and animals are naturally poisonous to humans but are sometimes prepared as food.

### ***Staphylococcal foodborne intoxication***

Staphylococcus organisms are usually present on our bodies, but luckily, not all types cause food poisoning. Only specific types that can produce toxins in food will cause trouble. Toxin-producing organisms may be found in the mouth and nose, infected cuts, boils, pimples, feces, and on dirty hands and arms. Two ways to prevent staphylococcal food poisoning are to prevent the bacteria from getting into food and by storing food under conditions that prevent growth of the organism and production of toxin.

#### ***Growth and survival***

Staphylococci like to grow and reproduce in warm, moist, high-protein foods. They can survive in higher salt and sugar concentrations than most pathogens. Therefore, cooked hams, custards, and cream filled pastries are especially conducive to the growth of staphylococcus organisms. A staphylococcal outbreak usually involves cooked foods. This is because this organism is a poor competitor and does not do well when other bacteria are present.

Cooking destroys most bacteria, but if staphylococci present on hands recontaminate food, they could grow and cause problems. Meats, egg products, and salads made from meat or eggs, and unacidified mayonnaise are also frequent offenders. At temperatures between 67 and 115°F, the organism can multiply to sufficient numbers and begin toxin formation. Cold does not kill the bacteria, but it inhibits multiplication and toxin formation. High temperatures kill the organism, but cannot destroy the toxin already produced. Even boiling does not destroy the toxin. For this reason, the toxin is considered “heat stable.”

#### ***Symptoms***

Symptoms of staphylococcal intoxication usually occur in two to four hours after consuming the toxic food. Symptoms may vary from mild nausea to extreme prostration with cramps, diarrhea, and often projectile vomiting. Recovery usually occurs within 24 to 36 hours; deaths have occurred as a result of staphylococcus food poisoning, but they are very rare.

#### ***Control measures***

Prevention of contamination and proper refrigeration are the keys to control. Foodhandlers with open sores, boils, cuts, skin rashes, or gastrointestinal upsets should not be allowed to work until they have been cleared for duty by a healthcare provider. Daily examination of foodhandlers by their supervisors is especially important to detect these problems. Educating foodhandlers, to wash their hands after coughing, blowing their noses, touching their faces, and visiting the latrine, is a basic step in preventing this illness. Use of wholesome products, clean utensils, proper handling techniques, and adequate refrigeration are vital. Nothing can be done to destroy the toxin except to throw out the food. An important rule to teach is “keep hot food hot and cold food cold.”

**Botulism**

The causative agent for this disease is *Clostridium botulinum*. This spore-forming organism grows in an absence of oxygen and produces a neurotoxin which is highly fatal even in small amounts. *C. botulinum* lives in decaying matter, soil, lake silt, and is often found in animal intestinal tracts. Food that comes in contact with contaminated soil picks up this organism which releases a toxin as it grows under anaerobic conditions. The toxin is destroyed by boiling for 5 minutes, but the botulinum spores are much more resistant. They may be killed by boiling for five hours at 212°F, or for 40 minutes at 238°F, using a pressure cooker. The spores' resistance to heat is the reason why under-processed, home-canned, garden vegetables have been the source of numerous cases of botulism. Non-acid foods such as peas, beans, corn, and meat are the worst offenders. Smoked, vacuum-packed fish, fermented meats, baked potatoes, and sautéed onions have also been involved in outbreaks.

**Symptoms**

Symptoms of botulism vary considerably, depending upon the amount of toxin ingested. Patients may experience symptoms 2 hours to 8 days, but usually within 12 to 48 hours after consuming the toxin. Common early symptoms include nausea, vomiting, abdominal pain, and diarrhea followed by double vision, loss of eye movement, and difficulty with speech, swallowing, and breathing. A descending symmetrical flaccid paralysis may progress until there is complete respiratory paralysis. Without treatment, the mortality rate is usually high at about 50 to 60 percent, and death may occur within 3 to 10 days after poisoning.

**Control measures**

Prevention of botulism is based upon proper preparation of foods. Foods should be stored at proper temperatures and cleaned prior to canning to prevent the growth of the organisms. Home-canned (which includes jars), non-acid foods should be avoided. Inspect all canned foods and discard bulging cans. When in doubt, throw it out. Do not taste to determine safety.

***Clostridium perfringens***

This is another anaerobic spore-forming organism that has gained considerable attention in recent years. It inhabits the intestinal tract of humans and animals and is extremely common in the soil.

The organism sporulates when the environment is not to its liking and the spores can contaminate food. All of the spores may not be destroyed during cooking. Once the spore is in the food and the proper conditions exist (i.e., temperatures of 113 to 120°F — temperatures to 127°F with moisture and time to grow), the organism germinates or returns to its original state. The organism begins to multiply and produces a toxin. Both the organism and toxin can be destroyed by temperatures of at least 165°F. This makes it very important for foods to be cooled properly after cooking and thoroughly reheated to 165°F. Cooked meats and poultry have been the chief offenders in outbreaks of foodborne illness involving *C. perfringens*. Unrefrigerated chicken broth provides an ideal culture medium. Rolled meat roasts, meat pies, and turkey are often the source of outbreaks. These types of foods or conditions set up a slightly anaerobic environment, which promotes the growth and reproduction of *C. perfringens*. Improper handling and processing of poultry and cooling of meat increase the hazard.

**Symptoms**

Symptoms of *C. perfringens* foodborne illness are generally of short duration, usually 1 day or less, and complete recovery usually follows. The symptoms, which appear in 8 to 12 hours, include acute abdominal pain, gas, diarrhea, chills, and fever. Nausea is mild, if present, and vomiting is uncommon, since this is primarily a lower intestinal syndrome.

### *Control measures*

Controls and preventive measures generally involve proper preparation and storage of meat and poultry dishes.

1. Serve foods hot, immediately after preparation. Cool leftovers rapidly (from 140 to 70°F. in 2 hours, and from 70 to 41°F. within an additional 4 hours) and reheat them rapidly to 165°F. In a refrigerated storage unit, it is best to leave foods uncovered until the cooling temperature has been reached and then cover the foods. The supervisors must continually monitor the temperatures during the cooling process.
2. Use a meat thermometer to ensure adequate, thorough cooking of thick cuts and interior portions.
3. Limit the depth of food such as stews and gravies, and use small containers for refrigerated storage.
4. Ensure proper techniques of handling and cleaning of vegetables and poultry.

### *Non-bacterial poisons*

In addition to bacterial poisons, chemicals from plants, animals, and seafood may be toxic when consumed. Among the offenders that have caused outbreaks of poisoning are fava beans, water hemlock, uncooked rhubarb leaves, mussels, some species of fish, shellfish that have eaten poisonous plankton, and some mushrooms. Two mushroom species of the genus *Amanita* are very dangerous. These species can cause neurologic disorders including brain damage and it can even result in death. Consumption of *A. muscarine* mushrooms may lead to symptoms within 2 minutes to 2 hours, and symptoms associated with *A. phalloidis* normally occur 6 to 15 hours after ingestion.

### *Inorganic chemicals*

Other types of non-bacterial poisons are inorganic chemicals. Included in this group are insecticides used on fruits and vegetables; copper and cadmium-plated, enameled (antimony), or galvanized (zinc) pots and pans used to prepare and store acidic foods; lead, fluorides, and cyanides. These chemical poisons often cause violent symptoms shortly (between 10 minutes and 2 hours) after ingestion.

### *Be careful*

Why do these illnesses occur? Mainly because people who prepare and serve food fail to apply known food protection measures. Carelessness and ignorance lead to contamination of food with bacteria or with material that cause foodborne illness.

## **223. Foodborne illness investigations**

When investigating foodborne illnesses we need to consider the factors involved and our responsibilities for the investigation.

### **Factors**

There is a certain sequence of events that must take place before a foodborne illness can occur. There must be an offending agent (pathogen) present, a vehicle to transmit the pathogen, a susceptible consumer, and an abuse of a foodhandling procedure. We do not live in a sterile world and must eat to survive; thus the agent, the vehicle, and the consumer will always be present. Foodborne illnesses are eliminated if safe foodhandling procedures are applied and practiced. Let us take a closer look at each sequence of events.

***Agent***

An analysis of data compiled by the Centers for Disease Control (CDC) reveals that over 68 percent of all confirmed cases of foodborne illnesses for the 10 years studied were attributed to a bacterial agent. Other agents involved in foodborne illnesses include:

- Chemical - 23 percent.
- Parasite - 6 percent.
- Viral - 3 percent.

These small percentages should not be equated with lack of importance! Chemical poisonings are high on the list as far as numbers of illnesses, and this type of illness could easily occur if we do not do our job in educating the foodhandler.

***Vehicle***

Some foods are better suited to bacterial growth. These foods are called Potentially hazardous foods (PHF). PHF are usually moist, with high-protein, and low-acid. However, all foods are susceptible to post-preparation contamination with pathogens or chemicals by foodhandlers. Be alert to all food handling deficiencies.

***Consumer***

This is the individual who eats the meal, buys the food at the commissary, or consumes the sandwich from a vending machine. Certain individuals are more susceptible to foodborne disease than others. The size, age, present health, and eating habits as well as the dose of the pathogen determine the effect the food has on an individual. These effects can vary from nausea to death.

***Abuse of foodhandling procedures***

Although this is our last consideration, it is the first to occur when a foodborne illness strikes a consumer. Foodhandling procedures actually begin when an item enters the food chain either at harvesting or during preparation.

***Responsibilities***

Now that you know the different types of foodborne illnesses, you need to know how PH investigates these illness outbreaks. The key to a successful investigation is developing and practicing a foodborne illness outbreak investigation plan. Each base has a slightly different plan, but the process is basically the same everywhere. At a minimum, you should exercise the foodborne illness investigation plan at your base annually. Hospital or medical personnel with initial patient contact should also receive training from PH in the proper procedures to follow during a suspected foodborne illness outbreak.

***Preparation***

Even if your base has a good food service sanitation program, a foodborne illness outbreak could still occur, and your office should be prepared to respond rapidly. Creating a foodborne illness outbreak kit will ensure all necessary items are ready to go in case something happens. The kit should contain such items as sterile bottles, gloves, tongs, spatulas, pencils, paper, and a supply of forms used in the investigation. Examples of forms to be used are AF Form 431, Food Poisoning Outbreak (Individual Case History); AF Form 432, Time Distribution of Persons Affected; and CDC Form 52.13, Investigation of a Foodborne Outbreak. Be sure to inventory your kit annually, and after each use, to ensure all needed items are present, and the sterile items are still intact.

***Notification***

To ensure a rapid response, a notification plan or recall roster should be developed by the MTF. As soon as medical authorities realize an actual outbreak may be in progress, the recall plan should be implemented.

### ***Investigation***

To properly investigate an outbreak, you need to understand the causes of an outbreak. Let us begin with a review of the factors involved in a foodborne illness outbreak. First, an infective agent or pathogen must be present. Then there must be a reservoir or source. Where did the organism come from? Is it common to a specific food item? Is it on a food contact surface that was not cleaned and sanitized properly? Microorganisms are nonmotile for all practical purposes; therefore, a mode of transmission is needed to move the organism from place to place. Did a gust of wind blow it into the food? Did a foodhandler transfer the organism on the hands or a utensil from its source to food?

There must be food present for the organism to grow. The temperatures must be adequate to support growth of the specific organism. There must be enough time for the organism to grow. This usually takes more than four hours.

Finally, there must be someone who is susceptible to a foodborne illness. While providers and medical personnel are examining and treating patients, other hospital personnel are collecting stool and vomitus samples for laboratory analysis. PH personnel and designated augmentees interview patients to try to determine the suspected food item. Questions should include foods eaten, times, and where the food was consumed. After interviewing patients, review the forms. They should identify a common meal or facility.

Once a common facility, meal, or food is suspected, an effort should be made to interview others who ate the suspected meal and are not ill. This will be used as a comparison later in the investigation. A sanitary evaluation of the suspect facility should be conducted immediately along with the collection of food samples, if available. Laboratory work should be progressing to identify the agent responsible for the outbreak.

### ***Sample collection***

Two types of samples must be collected. Human vomitus and stool samples are the first type of specimens collected. The second type is food samples from the suspected facility or facilities.

#### ***Human samples***

Vomitus and stool should be collected in sterile airtight containers and submitted to the medical laboratory for analysis. Only under extreme conditions should samples be sent out to other local area labs. **TIME IS CRITICAL!!** The sooner the agent is identified, the sooner patients can be treated and the suspected foods can be eliminated. However, the agent may not be identified until long after the outbreak is over. Remember to advise the lab of your suspicions as to the cause or etiology of the outbreak. If you suspect an anaerobic organism such as *C. perfringens*, the lab must attempt to grow the organism in an anaerobic as well as aerobic environment. Also, remember to make lab personnel aware of the possibility of *C. jejuni* and *L. monocytogenes* causing foodborne illnesses.

#### ***Food samples***

While the human samples are being collected, PH and augmentee personnel are collecting food samples from facilities. There should be two teams of PH personnel. One team can interview patients while the other is collecting food samples for laboratory testing. The teams keep in contact to ensure food samples are taken from common sources identified during the interviewing process. All samples must be aseptically collected to ensure the foods are not contaminated prior to testing. To implicate a specific agent, the same agent should be identified in the foods and the human stool and vomitus samples and also fit the symptoms exhibited by the patients.

At this point PH should have gathered information required to complete the investigation. As many people as possible should have been interviewed, including both sick people and well people who ate the suspected foods, and people who did not eat the suspected foods. A comparison of individuals eating and not eating specific foods is very important to complete the investigation.

If at any point in the investigation you become overwhelmed with work or are stumped as to the common food or facility, there is help available. The Air Force Institute for Environmental, Safety and Occupational Health Risk Analysis, Risk Analysis Directorate, the Epidemiological Surveillance Division (AFIERA/SDE) also has a team of experts that investigates foodborne illness outbreaks. If you need them, contact your MAJCOM PHO to request their assistance. They will help you, and they will make recommendations on how to improve your investigation capabilities.

### ***Reporting***

The best way to teach the proper method for completing the necessary forms for a foodborne illness outbreak is to create a hypothetical situation and complete the forms. So, that's what we will do here.

#### *Situation*

Assume that 100 people are at a picnic. The group consists of 50 couples, ranging in age from 21 to 40. At the picnic, the following menu is available: cold chicken, sliced ham, potato salad, baked beans, Jell-O, cola, beer, coffee, rolls, and butter. About 3 or 4 hours after eating, people from the picnic begin to appear at the hospital complaining of diarrhea, cramps, nausea, and vomiting. In order to plan a study of the cause of the outbreak, you implement your plan and interview the people involved and record the results of the interviews. What questions do you ask and to whom? What information do you want to obtain from the people interviewed? How will you tabulate the data so that it may be easily studied?

#### *Questions*

This is why the plan developed prior to the outbreak is very important. While planning, you decide what questions must be answered by PH investigation. The questions to ask yourself might include the following:

1. What organism caused the outbreak?
2. What food or foods contained the organism?
3. What caused the food (or foods) to become contaminated?
4. How could the outbreak have been prevented?

#### *Answers*

In order to answer the necessary questions quickly, you must first interview the sick people who are readily available. However, a representative number of well people should also be interviewed. To be more thorough, if time permits, all 100 people should be interviewed.

1. What questions are necessary to establish the identity of the organism? You know from previous study that organisms that cause foodborne illness have fairly predictable incubation times and symptoms. From this you can analyze the data to determine the common denominator. However, you must first determine three things:
  - a. What symptoms each person displayed and what were the common symptoms.
  - b. Which foods each person ate and the time the meal was consumed.
  - c. What time the symptoms began.
2. To identify the contaminated food item, you must establish a common denominator or meal, and the food or beverage from that meal that was consumed by those who became ill. To do this, obtain a 3-day food history from each individual. Using this information, complete an AF Form 431, Food Poisoning Outbreak – Individual Case History, on each individual (fig. 2-6). This form is designed to obtain data in food poisoning outbreaks. Study figure 2-6 and note that the form has ample space to record physical symptoms, onset, and duration. It also has space to record a chronological history of food consumed for the past 3 days, including snacks, along with the date, hour, and place.

FOOD POISONING OUTBREAK - INDIVIDUAL CASE HISTORY					CASE NO.
LAST NAME - FIRST NAME - MIDDLE INITIAL Romero, Beavis, B.				QUARTERS Yes	
SYMPTOMATOLOGY					
ONSET OF SYMPTOMS (Date and hour) 1 Apr 93 / 0001			DURATION OF SYMPTOMS 3 days		FEVER Yes
NAUSEA, VOMITING (Frequency) 1 x per hour			DIARRHEA (No. of stools, water, bloody, mucous, pus) 20, bloody, mucous		
ABDOMINAL DISCOMFORT (Cramps, tenesmus) cramps			OTHER (Specify)		
LABORATORY SPECIMENS FROM THIS PATIENT					
EPIDEMIOLOGY (FOOD AND DRINK 3 DAYS PRIOR TO ONSET)					
OCCASION	DATE	HOUR	PLACE	ARTICLES OF FOOD AND DRINK	
BREAKFAST	29 Mar 93	0630	Home	Bacon, eggs, toast, coffee	
LUNCH		1100	Bowling Center	Cheeseburgers, fries, tea	
DINNER		1830	Home	beer Catfish nuggets, mashed potatoes, corn	
OTHER (Snack)		1500	Office	Ice cream fudge bar	
BREAKFAST	30 Mar 93	0630	Home	Pancakes, sausage, choc. milk	
LUNCH		1130	Jainito's Tacos	Chicken flautas, beans, rice, tea	
DINNER		1900	China Garden	shrimp egg roll Sesame chicken, fried rice, tea	
OTHER (Snack)					
BREAKFAST	31 Mar 93	0630	Home	Peanut butter & jelly sandwich, coffee	
LUNCH		1215	Commissary	Mixed sub, chips, coke	
DINNER		1830	Home	Spaghetti w/meatballs, garlic bread, coke	
OTHER (Snack)					
ADDITIONAL INFORMATION (Others accompanying patient at any of the above meals, with or without illness, etc.)					
MEDICAL FACILITY 70th Medical Facility, Brooks			SIGNATURE OF PERSON COMPLETING FORM Daiga M. Koenig		

AF FORM 431

\* U.S. GOVERNMENT PRINTING OFFICE: 1986-153-309

Figure 2-6. Sample, AF Form 431.

*Record history*

After all individuals have been interviewed and food histories recorded on AF Form 431, you should have an idea of how many people consumed each food item and the number of people who are ill in relation to each food item. The interview should include a food history for the past 72 hours.

*Use forms*

CDC Form 52.13, Investigation of a Foodborne Outbreak, has been designed for recording your data analysis (figs. 2-7A and 2-7B). This form puts a special emphasis on section 7, food-specific attack rates, to help determine the suspected food item (or items). You should complete and distribute the form in accordance with AFI 48-116, *Food Safety Program*.

*Time the symptoms*

Next, you need a tabular picture of what time the symptoms of the illness began. AF Form 432, Time Distribution of Persons Affected, figure 2-8, is used for this purpose. One of these forms is used for each FBI outbreak. All you have to do is enter calculations from individual case histories in the right-hand column of the form.

CDC USE ONLY

☐ ☐ ☐ ☐

(1-4)

This report is authorized by law (Public Health Act, 42 USC 241). While your response is voluntary, your cooperation is necessary for the understanding and control of the disease.

FORM APPROVED  
OMB NO. 0920-0004

### INVESTIGATION OF A FOODBORNE OUTBREAK

<b>1. Where did the outbreak occur?</b> State <u>Texas</u> (5-6) City or Town <u>Brooks AFB</u> Country <u>Bexar</u>					<b>2. Date of outbreak: (Date of onset 1st case)</b> <u>7/4/95</u> MO/DA/YR (7-12)							
<b>3. Indicate actual (a) or estimated (e) numbers:</b> Persons exposed <u>100</u> (13-17) Persons ill <u>46</u> (18-22) Hospitalized <u>0</u> (23-27) Fatal case <u>0</u> (28-31)			<b>4. History of Exposed Persons:</b> No. histories obtained <u>75</u> (32-35) No. persons with symptoms <u>46</u> (36-39) Nausea <u>10</u> (40-43) Diarrhea <u>37</u> (44-47) Vomiting <u>3</u> (48-51) Fever <u>11</u> (52-55) Cramps <u>46</u> (56-59) Other, specify <u>Headache</u> <u>6</u> (60-79)			<b>5. Incubation period (hours):</b> Shortest <u>1</u> (80-83) Longest <u>10</u> (84-87) Approx. for majority <u>4</u> (88-91) <b>6. Duration of illness (hours):</b> Shortest <u>4</u> (92-95) Longest <u>18</u> (96-99) Approx. for majority <u>10</u> (101-104)						
<b>7. Food - specific attack rates:</b>												
Food Items Served				Number of persons who ATE specified food		Number who did NOT eat specified food						
	Ill	NOT Ill	Total	Percent Ill	Ill	NOT Ill	Total	Percent Ill				
Cold Chicken	30	11	41	73	23	11	34	68				
Sliced Ham	43	11	54	80	3	18	21	14				
Potato Salad	29	17	46	63	17	12	29	59				
Baked Beans	26	17	43	60	20	12	32	62				
Jello	4	2	6	67	42	27	69	61				
Cola	23	15	38	62	23	14	37	62				
Beer	13	11	24	54	33	18	51	65				
Coffee	19	12	31	61	27	17	44	61				
Rolls & Butter	21	16	37	57	25	13	38	66				
<b>8. Vehicle responsible (food item incriminated by epidemiological evidence):</b> (105-106)												
<b>9. Manner in which incriminated food was marked: (Check all Applicable)</b> (a) Food Industry Raw <input type="checkbox"/> (107) Processed <input checked="" type="checkbox"/> (108) Home Produced Raw <input type="checkbox"/> Processed <input type="checkbox"/> (110) (b) Vending Machine <input type="checkbox"/> (111)					(c) Not wrapped <input type="checkbox"/> (112) Ordinary Wrapping <input checked="" type="checkbox"/> (113) Canned <input type="checkbox"/> (114) Canned - Vacuum Sealed <input type="checkbox"/> (115) Other (specify) <input type="checkbox"/> (116) (117-129) (d) Room Temperature <input type="checkbox"/> (130) Refrigerator <input checked="" type="checkbox"/> (131) Frozen <input type="checkbox"/> (132) Heated <input type="checkbox"/> (133)				<b>10. Place of Preparation of Contaminated Item: (151)</b> Restaurant <input type="checkbox"/> 1 Delicatessen <input type="checkbox"/> 2 Cafeteria <input type="checkbox"/> 3 Private Home <input type="checkbox"/> 4 Caterer <input type="checkbox"/> 5 Institution: School <input type="checkbox"/> 6 Church <input type="checkbox"/> 7 Camp <input type="checkbox"/> 8 Other Specify <input checked="" type="checkbox"/> 9 <u>NCO Club</u> (152-171)		<b>11. Place where eaten: (172)</b> Restaurant <input type="checkbox"/> 1 Delicatessen <input type="checkbox"/> 2 Cafeteria <input type="checkbox"/> 3 Private Home <input type="checkbox"/> 4 Picnic <input checked="" type="checkbox"/> 5 Institution: School <input type="checkbox"/> 6 Church <input type="checkbox"/> 7 Camp <input type="checkbox"/> 8 Other Specify <input type="checkbox"/> 9 (173-192)	
If a commercial product, indicate brand name and lot number <u>Blue Hawk Brand X, USDA Est.</u> (134-150)												

DEPARTMENT OF HEALTH AND HUMAN SERVICES  
PUBLIC HEALTH SERVICE  
CENTERS FOR DISEASE CONTROL  
ATLANTA, GEORGIA 30333

Figure 2-7A. Sample, CDC Form 52.13 (front).

[illegible]

**Figure 2–7B. Sample, CDC Form 52.13 (back).**

\* U.S. GPO 1956-152 206

**Figure 2–8. Sample, AF Form 432**

*Start solving the problem*

Now that you have stated the problem, collected the pertinent facts, and tabulated or charted the data, it is time to solve the problem. Why did the food cause illness and what must be done to prevent its recurrence? If you analyze the data collected, you should get a partial answer. You know that staphylococcus organisms create toxins that have an average incubation period of 2 to 4 hours. Therefore, you have a definite clue to the causative agent in your foodborne illness outbreak. You know that staphylococcus grows readily in high protein salads, pastries, custards, and sliced meats. The scenario has suspected carriers such as the ham, chicken, and potato salad. The table of foods consumed by the affected persons may supply the exact answer, or it could show as many as two, three, or more, likely suspects. The mathematical approach is the method most likely to give the most accurate solution. First, determine the number and percent of people involved in the “food specific attack rates.”

*Start drawing conclusions*

On the example, the 75 persons who provided histories, 46 ate the potato salad, but only 29 of these people got sick. Of the 29 people who did not eat the potato salad, 17 became ill. Based on these findings, the potato salad is probably not the source of infection. The most likely suspect was the sliced ham, with 80 percent of those who ate it becoming ill. Fourteen percent of the people who did not eat the ham (3 people out of 21) became ill. However, 11 people ate sliced ham and did not get sick. This is not unexpected. Those who were exposed and were not affected may have received a smaller dose of toxin than those who became ill; or their serving of the food item may not have contained the agent; or some data may be incorrect because of faulty memory concerning foods actually eaten. There could be other factors. At any rate, from analysis of the data (symptoms and onset data shown in figure 2-7A), you can make an *assumption* that the causative agent was staphylococcus enterotoxin and that the probable vehicle was sliced ham.

*Confirm conclusions*

In order to confirm that sliced ham was the vehicle, laboratory analysis should be performed on all items from the picnic, if available. However, to save time, you must assume that you have drawn the correct conclusion and look for the source and method of contamination. By questioning the picnic organizer, you can determine how the meat was prepared, sliced, and delivered. Also, by careful, diplomatic investigation, you may even discover the source of the staphylococcus contamination in the ham. In this part of the investigation, tact and diplomacy are vital factors in producing facts. No one likes to admit carelessness or oversight, especially if it is the cause of an outbreak of illness.

*Educate*

Most importantly, after an investigation of this kind, use your data analysis to educate people about the dangers of foodborne illness. Thereby, future outbreaks may be prevented.

*Complete the investigation*

If an outbreak should result from a meal served in a dining hall, additional steps may be required to complete the investigation. These include obtaining a menu, a thorough inspection of the dining hall, interviewing personnel who prepared the suspected foods, and obtaining food samples, if available.

*Cost of outbreaks*

Obviously, outbreaks of foodborne illness can be costly when you compute lost hours on the job, hospitalization costs, human suffering, and even death. In most instances, these occurrences can be prevented. Do not think that a foodborne illness cannot happen at your base. It can happen! The Air Force has had many foodborne illnesses due to base facilities, and PH personnel had to investigate the cause. You must be prepared for any foodborne illness outbreak investigation. If you don't have a plan ready to use—get to work on it now!

### Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

#### 222. Common foodborne illnesses

1. How soon after ingestion of foods contaminated with *Salmonella* will symptoms occur?
2. What are the symptoms of a streptococcal infection transmitted through food?
3. What are the symptoms if a person is infected with *C. jejuni*?
4. What are the manifestations of *Listeria monocytogenes*?
5. Why is *Listeria monocytogenes* an important pathogen?
6. What is the most common cause of foodborne intoxications?
7. How is the toxin produced from *Staphylococcus* organisms destroyed?
8. What are the symptoms of *Clostridium perfringens* foodborne illness?

#### 223. Foodborne illness outbreak investigations

1. What factors must be present for a foodborne illness to occur?
2. After notification of a foodborne illness, when should a sanitary evaluation be conducted at a suspected facility?
3. Where can you get help with investigating a foodborne illness, if you are overwhelmed?
4. On what form do you record food history for each individual interviewed?

## 2-6. Rabies Control Program

With the threat of rabies existing in the United States, the Air Force has developed a program designed to control the spread of the disease. The program consists of pet vaccination, stray animal control, public education, and an animal bite control program. First, let us look at the disease of rabies.

### 224. Rabies

Rabies is a widespread viral disease which affects any warm blooded animal. It is almost always fatal in affected animals, including humans. The disease is found in animals in most parts of the world; however, it is rarely found in humans in the United States, although animals in many of the states carry the disease and could easily transmit it to humans.

#### Causative agent

Rabies is a virus that affects the central nervous system, and results in a fatal encephalitis. The incubation period is variable in different species of animals; it depends on the severity of the wound, site of the wound in relation to the richness of nerve supply and its distance from the brain, amount and strain of virus introduced, and protection provided by clothing and other factors. It also varies from animal to animal within the same species. In the dog, the incubation period usually lasts 15 to 25 days, but may exceed 120 days, which is why most rabies-free countries insist on a 180-day quarantine period for incoming dogs.

#### Symptoms

Symptoms in humans are divided into five stages. The **first** stage is the incubation period which usually is between 14 and 90 days after exposure. The **second** stage is the prodrome phase, when individuals show the first clinical symptoms. These symptoms can be fever, headache, malaise, sore throat, and a cough or abdominal pain. These symptoms last for 2 to 4 days. Then the **third** stage, which is known as the acute neurological phase, begins. The symptoms for the third stage may include aseptic meningitis, encephalitis, or neuropathies. This phase is also accompanied by periods of hyperactivity, excitability, and increased salivation. Patients may have pharyngeal spasms when trying to drink water, or even with the sight of water. (This is the reason the term “hydrophobia” is associated with rabies.) This third neurological phase lasts from 2 to 7 days, and ends with the onset of a coma. The coma (or **fourth** stage) may last up to 14 days. Death or recovery is the **fifth** stage.

The clinical signs of rabies infection in animals may also vary depending upon the stage of disease.

#### Mode of transmission

The disease is usually transmitted by the saliva of infected animals. Usually a break in the skin such as a cut or scratch, is necessary for infection to occur.

#### Domestic animals

Rabies is usually associated with the bite of an infected animal. Saliva of infected dogs, cats, and even ferrets may contain the virus for several days before they appear clinically ill. This is why domestic animals involved in biting incidents are held in quarantine for 10 days; if the virus was in the saliva at the time of the bite, then the animal will appear ill within 10 days. Then the bitten person can begin antirabies immunization. If the biting animal remains healthy for 10 days, then the bitten person need not receive antirabies immunizations. If the biting animal is not found and observed for 10 days, then the bitten person often begins receiving the antirabies immunizations. These immunizations, which are categorized as artificial active immunity, are a necessary precautionary measure since the disease is so severe. An important point to remember—the treatment has to be given before the person starts showing signs of encephalitis. After that, the immunizations will not work.

***Unusual transmissions***

Rabies virus may also be transmitted by aerosol in unusual circumstances. A few human cases have occurred after exploring infected bat caves. Infection may also occur following ingestion of infected animals. Neither of these routes is very likely for humans. Rabies also has been transmitted by corneal transplantation from one human to another.

***Wild things***

Various wild species serve as reservoirs of rabies infection in the United States. Skunks are important reservoirs in the Mississippi River Valley; foxes are important along the eastern seaboard; raccoons in Florida, Virginia, and Georgia; and bats in various locales containing bat caves. In most foreign countries dog rabies is the main problem due to large stray dog populations that maintain the infection. Rabies may be diagnosed at various laboratories using brain tissue from suspected animals. This is why the heads of suspected animals are shipped to a laboratory for testing.

**Treatment for infected animals**

There is no treatment for infected animals. This is also true for humans once the encephalitis signs appear. In fact, the usual recommendation is euthanasia for any exposed pet, vaccinated or not. The disease is just too serious to take any chances. Pets are vaccinated primarily to prevent them from transmitting the disease to humans, not just for their own protection.

**225. Animal bite control program**

It is obvious to see how serious rabies is. It is a complicated disease to administer as well.

**Responsibilities**

Before explaining the process of administering the Rabies Control Program, you need to know who is involved and understand their job.

***Healthcare provider***

The healthcare provider (HCP) has one of the hardest jobs in this program. The HCP is responsible for the treatment of the patients. If bitten people do not receive the antirabies immunization soon enough after exposure, their chances of dying are greater. The decision to receive antirabies immunizations is very difficult without further information. This information is necessary and is provided by other offices.

***Emergency room technicians***

You will be dealing with technicians in the emergency room, as well as other clinics, to determine if any animal bite cases were reported but the paperwork never made it to your office. The emergency room keeps logbooks on all patients, which is a good source of information if you need it.

***PH***

One of the “other” offices is your PH office. Your office is responsible for monitoring the overall program, ensuring that the patients receive treatment, determining if the animals have been found and placed in quarantine by qualified individuals, and to determine the risk of active rabies in the biting animals.

***Army veterinarian***

The Army veterinarian is responsible for ensuring the biting animals are quarantined and determining whether the animals have rabies. If a biting animal cannot be found, the Army veterinarian provides information for the local area about the incidence of rabies in the species of biting animal. This veterinarian also is involved as a resource about the disease who provides information about the disease to members of the Rabies Advisory Committee.

***Local public health agency***

This agency handles all off-base bite cases in place of the Army veterinarian, who is responsible for the quarantine process and for submitting samples for laboratory testing, if required.

***Security police***

The Security Police is responsible for retrieving stray animals that are involved in bite cases on base and for ensuring on-base residents follow quarantine procedures as prescribed by the MTF Commander and Base Commander.

***Rabies Advisory Committee***

Members of this group include a few physicians (at least two physicians, with one from Aeromedical services and one from hospital or clinical services), the chief of Public Health Services, and a veterinary officer who is usually an Army veterinarian. The group is established in accordance with AFI 48-105 by the director of base medical services. This group must be available for an attending physician who is treating a victim of an animal bite. This group also reviews all cases where rabies exposure is possible.

***Purpose and importance of control***

Only a handful of patients have ever survived rabies once they developed the clinical signs of encephalitis, because treatment is almost useless once these signs begin. This fact alone makes it extremely important that all people who are bitten by an animal receive a medical examination to determine if they have been exposed to rabies. If someone has been exposed to rabies, the success of antirabies immunization is directly related to how soon after the exposure the immunizations are started. In other words, the longer the person waits to get treated after being bitten by a rabid animal, the greater the chance of dying.

***Treatment***

On the other hand, no one should get treated unless it's necessary. Antirabies immunizations, like all medication, can cause medical problems. They can be painful, and there is a slight chance someone may have a severe reaction to the antirabies vaccine.

***Prevention***

Prevention of human rabies is provided by administration of human rabies immune globulin (HRIG) as soon as possible after exposure to neutralize the virus in the bite wound, and then by giving vaccine to elicit active immunity. The human diploid cell vaccine (HDCV) has been licensed for use as an antirabies immunization since 1980. The HDCV should be given as soon as possible after the bite and may be given at the same time as the RIG. Other doses of HDCV are administered at 3, 7, 14, and 28 to 35 days after the first dose.

***Problem decision***

There is a problem like a two-edged sword. If someone is bitten, the doctor who tends to the victim has to decide if the patient needs antirabies treatment. If the patient has been exposed to rabies and the doctor does not give antirabies treatment, the patient may die. If, on the other hand, the patient has not been exposed to rabies and the doctor gives the antirabies treatment, the patient may experience an unnecessary reaction.

***Complicated problem***

The attending physician must make a decision whether or not to give treatment. This is where the problem gets complicated. The provider needs to know if the animal is rabid. As mentioned earlier, the way to determine if an animal has rabies or not is either through quarantine or examining the brain tissue at a laboratory. The latter would require the animal be killed and the head sent to a laboratory. If the brain tissue is positive for rabies, the patient should receive the antirabies treatment. If the tissue is negative for rabies, the patient does not need the treatment.

***Other questions***

Some other questions the provider might need to know: Where is the animal? Is it dead or alive? If it's alive, can it be killed and the head sent to a laboratory? How long will it take for the results of the specimen? Is the biting animal a dog, cat, or ferret? Can the animal be quarantined for 10 days? Is the animal apparently healthy? Was the animal provoked? Who will quarantine the animal and notify the doctor of the animal's health at the end of quarantine? These and other questions need to be answered so the doctor can provide the patient with the best possible care. All of the agencies involved must work together as a team to ensure the proper treatment of the patient.

**Administration of the program**

A DD Form 2341, Report of Animal Bite – Potential Rabies Exposure (figs. 2-9A and 2-9B), is used to transmit animal bite information from the emergency room to PH, to the quarantine officials, and back to be filed in the patients medical records. When time is critical, use the telephone to ensure the patient receives prompt accurate care from the provider.

***Track the form***

It is your responsibility in PH to track the DD Form 2341 throughout the Animal Bite Program process. Ensure personnel at each section the form goes to understand that the form cannot just sit on someone's desk. Explain to them that it is important to either complete their portion of the form or to send it on to the next section with an explanation why they could not complete their section. Because this process is complicated and confusing with all of the different people involved, the Air Force set up the Animal Bite Control Program, with PH as the OPR or office of primary responsibility.

***Scenario***

Let us take an example through from the beginning to the end. Look at figures 2-9A and 2-9B and follow along as you work through the example. Assume that a 15 year old boy was bitten by a dog on an Air Force base. The base is located in an area where rabies is endemic and can be easily transmitted to dogs in the area. There have been a few cases of stray dogs in the area that have been put to sleep and their heads sent to be examined for rabies. One of these dogs came up positive for rabies.

REPORT OF ANIMAL BITE - POTENTIAL RABIES EXPOSURE (Please read Privacy Act Statement on back before completing this form)						SEQUENCE NUMBER 95 - 001	
1. FROM (Medical Treatment Facility) Wilford Hall Med Center		2. THRU (Deputy Commander for Veterinary Services) Lackland Vet Office		3. TO (Chief, Preventive Medicine) Public Health			
<b>PART I - ANIMAL BITE HISTORY</b> (To be completed by Emergency Room Interviewer)							
4. DESCRIPTION OF ANIMAL						5. TIME OF ATTACK	
a. TYPE (Dog, cat, etc.) Dog	b. BREED Chihuahua	c. SIZE Small	d. COLOR Brown	e. SEX F	a. DATE 19 Apr 95	b. HOUR 1700	
6. PRESENT LOCATION OF ANIMAL OR GEOGRAPHIC ADDRESS WHERE ATTACKED <input checked="" type="checkbox"/> ON POST <input type="checkbox"/> OFF <input checked="" type="checkbox"/> POST							
7. CIRCUMSTANCES LEADING TO BITE / SCRATCH INCIDENT I wanted to play with the dog since it was the first time I met her. So, I decided to push her away from her favorite toy bone. Then I tried to grab the bone but, when I knelt down to get it she lunged at my throat.							
8. APPARENT HEALTH OF ANIMAL (Unusual Behavior) Normal							
9. OWNER							
a. NAME (Last, First, Middle Initial) Martinez, Mike		b. STATUS (X one) <input checked="" type="checkbox"/> MILITARY <input type="checkbox"/> CIVILIAN		c. PHONE NUMBER (Include Area Code) 536 - 2059		d. ADDRESS (Street, City, State, Zip Code) 28 Starcrest Cir Lackland AFB, Tx. 78236	
10. RABIES VACCINATION							
a. VACCINATION STATUS OF ANIMAL 11 - 94 Rabies		b. YEAR ANIMAL VACCINATED 1994		c. TYPE VACCINE (If Known)			
11. PREPARED BY							
a. NAME (Last, First, Middle Initial)				b. TITLE			
c. SIGNATURE				d. DEPARTMENT / SERVICE / CLINIC		e. DATE PREPARED	
<b>PART II - MANAGEMENT OF ANIMAL BITE CASE</b> (To be completed by Medical Officer (Information from SF 600))							
12. DESCRIPTION OF INJURY AND LOCATION ON THE BODY Severe Laceration to jugular vein.							
13. DIAGNOSIS (Injury) (X, as applicable)				14. RABIES RISK ESTIMATE (X, one)			
<input checked="" type="checkbox"/> ANIMAL BITE		<input type="checkbox"/> CLAW WOUND		<input checked="" type="checkbox"/> MINIMAL		<input type="checkbox"/> MODERATE	
<input type="checkbox"/> OTHER		<input type="checkbox"/> OTHER		<input type="checkbox"/> MODERATE		<input type="checkbox"/> HIGH RISK	
15. INITIAL TREATMENT GIVEN				16. RECOMMENDED FURTHER PROPHYLACTIC TREATMENT			
a. TIME 1730		b. DATE 19 Apr 95		<input checked="" type="checkbox"/> a. NONE			
<input checked="" type="checkbox"/> c. DEEP FLUSHING AND CLEANSING WITH SOAP AND WATER				<input type="checkbox"/> b. * HUMAN RABIES IMMUNE GLOBULIN			
<input type="checkbox"/> d. TETANUS TOXOID (List dose given)				<input type="checkbox"/> c. HUMAN DIPLOID CELL RABIES VACCINE			
<input type="checkbox"/> e. OTHER (Specify)				<input type="checkbox"/> d. COUNSELED ON DF2 HAZARD			
				<input type="checkbox"/> e. OTHER (Specify)			
				* Need to consult Rabies Board prior to treatment			
17. PATIENT'S IDENTIFICATION (ID impression, if available.) (For typed or written entries give name (Last, First, Middle Initial); pay grade; SSN; unit; phone; date; hospital or medical facility.)  Bocel, Tom TSgt USAF 123 - 54 - 9876 4 - 2058 19 Apr 95 WHMC				18. PHYSICIAN			
				a. NAME (Last, First, Middle Initial) Physician, J Wanna B. A.			
				b. SIGNATURE J Wanna B. A. Physician			
				19a. DISCUSSED WITH AREA VETERINARIAN (X one) <input checked="" type="checkbox"/>			
				b. NAME OF VETERINARIAN (Last, First, Middle Initial)			
				20. VERBAL REPORT TO			
				(1) NAME		(2) PHONE NO.	
				a. VETERINARIAN			
				b. POLICE			
				c. OTHER			

Figure 2-9A. Sample, DD Form 2341 (front).

PRIVACY ACT STATEMENT					
<b>AUTHORITY</b> Title 10, United States Code, Sections 3013, 5013, and 8013 <b>PRINCIPAL PURPOSE(S):</b> Used by medical authorities to record the history, examination, and treatment of a person who has possibly been exposed to rabies; and to record the follow-up medical care provided to the individual who was either bitten or scratched. Used by veterinarians to locate the animal, record examination, observation, and disposition results, and possible laboratory findings for the animal. <b>ROUTINE USE(S):</b> Information will be used as a basis for documenting the proper treatment and care for individuals who have potentially been exposed to rabies. The information will be used to locate the animal, and record the vaccination and physical status of the involved animal. The information may also be used to: aid in preventive health and communicable disease control programs; report medical conditions required by law to federal, state and local agencies; compile statistical data; conduct research; teach; assist in law enforcement, to include investigation and litigation; and to evaluate the care provided. <b>DISCLOSURE:</b> Voluntary; however, if the information is not provided, it will delay the compilation of the data required for record keeping purposes.					
<b>PART III - MANAGEMENT OF BITING ANIMAL (To be completed by Veterinarian)</b>					
<b>21. AUTHORITIES NOTIFIED</b>					
<b>a. NAME (Last, First, Middle Initial)</b>	<b>b. DATE</b>	<b>c. TIME</b>	<b>d. INITIALS</b>	<b>e. FOLLOW - UP</b>	
				<b>(1) DATE</b>	<b>(2) TIME</b>
Vet Svs.	20 Apr 95	0800	UWB		0800
<b>22. INITIAL ACTION</b>			<b>23. EMERGENCY ROOM NOTIFIED</b>		
			<b>a. TIME</b>	<b>b. DATE</b>	<b>c. INITIALS</b>
<b>24. LOCATION OF ANIMAL DURING OBSERVATION PERIOD (On or off post, list point of contact if not veterinary activity)</b>					
Home					
<b>25. OBSERVED BY (Include name of military or civilian agency)</b>					
Vet Svs.					
<b>26. DATES OBSERVED</b>			<b>27. DATE ANIMAL RELEASED</b>		
<b>a. FROM</b> 19 Apr	<b>a. FROM</b> 30 Apr	30 Apr			
<b>28. CONDITION OF ANIMAL DURING AND AT THE END OF 10-DAY QUARANTINE</b>					
<b>29. OTHER DISPOSITION OF ANIMAL (Explain fully - died, escaped, not located, etc.)</b>					
<b>30. LABORATORY FINDINGS OF ANIMAL SUBMITTED FOR RABIES DIAGNOSIS</b>					
<b>a. TEST (X one)</b>		<b>b. DATE RECEIVED</b>		<b>c. RESULTS (X one)</b>	
(1) FLUORESCENT ANTIBODY				NEGATIVE	
(2) CELL CULTURE				POSITIVE	
<b>31. INFORMATION REPORTED TO RABIES BOARD BY</b>					
<b>a. NAME (Last, First, Middle Initial)</b>		<b>b. SIGNATURE</b>		<b>c. DATE SIGNED</b>	
<b>32. VETERINARY OFFICER</b>					
<b>a. NAME (Last, First, Middle Initial)</b>		<b>b. SIGNATURE</b>		<b>c. DATE SIGNED</b>	
<b>PART IV - RABIES ADVISORY TEAM ACTION / BOARD REVIEW</b>					
<b>33. DISCUSSED BY (List names of members of team or board, or X box at right)</b> <input type="checkbox"/> NOT REQUIRED TO MEET					
<b>34. RECOMMENDATIONS</b>					
<b>a. HUMAN RABIES IMMUNE SERUM (X one)</b> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>					
<b>b. VACCINE</b>					
<b>c. OTHER</b>					
<b>35. CHIEF, PREVENTIVE MEDICINE</b>					
<b>a. NAME (Last, First, Middle Initial)</b>		<b>b. SIGNATURE</b>		<b>c. DATE SIGNED</b>	
<b>36. FINAL DISPOSITION OF CASE (Review by rabies board)</b>					
<b>37. PRESIDENT OR SENIOR MEDICAL OFFICER OF BOARD</b>					
<b>a. SIGNATURE</b>				<b>b. DATE SIGNED</b>	

Figure 2-9B. Sample, DD Form 2341 (back).

*Who bit whom*

The boy and his parents report to the emergency room at the base hospital for treatment. The emergency room technician imprints the personal information at the bottom of the form. The technician also asks some important questions: Who owns the dog? Description of the dog? When attacked? Present location of the animal? What events led up to the attack? Did the health of the dog seem okay? The parents said they do not own the dog and they do not know who does. The dog is a mixed breed, but predominantly Chihuahua with a small build, and the color was tan, brown, and white. The attack occurred at 1700 hours on 19 April 01 on Starcrest Street near the Child Care Center. The bite occurred on base, and the boy was riding his bicycle down the street when he saw the dog and stopped to play.

*Don't know*

There did not seem to be any tag or collar on the dog and none of the neighbors knew who owned the dog. The technician completes the prepared by block and calls PH for assistance.

*Unknown condition of biter*

The provider, in the mean time, examined the boy and determined the wound to be a bite on the neck, with the wound being cleaned and dressed. The boy's tetanus shot was up-to-date so no tetanus vaccination was necessary. The provider marks the high risk for rabies exposure due to the unknown condition of the dog. The provider cannot determine if treatment is necessary yet, more information is needed.

*What to do*

You answer the phone from the technician's call and take the information. You tell the technician that you will call back with more information. What could you do to get more information for this case?

*Start your investigation*

One thing you can do, realizing that there is more than one answer to each situation, is to call the security police and have them look in the area for a stray dog. Since the bite occurred near the Child Care Center, the security police send several units to that location. You get a call back from the security police in about 30 minutes; they found the dog. They took the animal to the quarantine kennel. You need to ensure a positive identification of the animal. After a positive identification, you call the Army Support Veterinarian and request the animal be put to sleep for submission to the laboratory for rabies testing. You let the provider know that the dog is in custody and that the animal is to be tested for rabies, and that the results will be known in 24 to 48 hours. The provider then decided to hold off on the immunizations until the information from the lab came back. The provider also asked for a telephone call to all Rabies Advisory Committee members for confirmation of this decision. In this scenario, the test results came back negative and the boy did not have to take the immunizations. However, this is not always the case, many people are bitten and the animal is never found, thus, subjecting them to the immunizations.

*Don't forget the paperwork*

It should be pointed out that throughout this procedure, you must complete the DD Form 2341 Part III, or the section on the management of the biting animal. You must put down who you contacted including the date, time, name, your initials and if any follow-up was completed. Complete the section on who supervised the quarantine, if applicable, and where was the quarantine conducted. If quarantined, complete the disposition of animal as well as health of animal at end of quarantine period. If the animal was submitted for lab testing, record the results as appropriate. Also, get the signatures of the Committee members if required.

***Follow through***

Once completed, the original form will be filed in the patient's medical records, while one copy is forwarded for Committee review, and one copy is filed in PH. Each base situation is different. Do not base your decisions in a case by this example. This example is for teaching purposes only.

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**Self-Test Questions**

**After you complete these questions, you may check your answers at the end of the unit.**

**224. Rabies**

1. How many stages are there for human symptoms of rabies?
2. What are the symptoms of the second stage (Prodrome phase) of rabies?
3. What is the fourth stage of rabies?
4. The antirabies immunizations are given before symptoms of what condition?
5. What is the usual recommendation for exposed pets whether vaccinated or not?

**225. Animal bite control program**

1. What are the responsibilities of the Army veterinarian in the rabies control program?
2. What two immunizations are recommended for individuals who have been exposed to rabies?
3. What tissue in an animal is examined for rabies virus?
4. What form is completed for animal bite victims reporting to medical treatment facilities?

5. Who is responsible for tracking the DD Form 2341 throughout the entire animal bite program process?
6. Where is the original of the DD Form 2341 placed once completed?

---

### Answers to Self-Test Questions

#### 209

1. An inflammation of the meninges, or covering of the brain and spinal cord.
2. Bacterial.
3. Haemophilus.
4. Viral, or aseptic.
5. To prevent complications such as rheumatic fever, kidney inflammation, or scarlet fever.
6. Antigenic drift.
7. To identify new strains of influenza virus.

#### 210

1. A communicable disease affecting the lungs.
2. *Mycobacterium tuberculosis*.
3. By the inhalation of droplet nuclei.
4. Infection, dormant, and active.
5. Bacilli encapsulate and remain in the alveoli of the lung until conditions favor further growth and progression to the active stage.
6. Fatigue, weight loss, fever, chills, night sweats, loss of appetite, and a persistent cough.
7. Mantoux.
8. 48 to 72 hours after initiating the test.
9. Bacille Calmette-Guerin.
10. To prevent the recipient from experiencing a natural primary TB infection by artificially inducing a harmless primary infection.
11. Positive skin tests for about 10 years; after 10 years, negative.
12. Sputum cultures.
13. Isoniazid (INH).
14. Drug-induced hepatitis.
15. Oversee the administration of the Program and educate personnel about the disease.

#### 211

1. Primary, secondary, and late.
2. *Treponema pallidum*.
3. 21 days.
4. Darkfield microscopy.
5. VDRL.
6. Fluorescent treponemal antibody-absorption.

**212**

1. *Neisseria gonorrhoeae*.
2. Thick whitish-yellowish discharge of pus, swollen meatus, difficult urination with painful burn.
3. Salpingitis.
4. Mild to severe sore throat, fever, and chills.
5. Gonorrhea of the bloodstream.
6. Intracellular.
7. Patient acceptability, patient reliability, medication effectiveness, side effects of the medication, and the presence of other diseases.
8. When symptoms persist after treatment.

**213**

1. *Chlamydia trachomatis*.
2. Like viruses: grow intracellularly. Like bacteria: contain both RNA and DNA, divide by binary fission, and have cell walls similar to gram-negative bacteria.
3. 7 to 14 days or longer.
4. Conjunctivitis and pneumonia.
5. Tissue cultures.
6. They are not recommended.

**214**

1. Genitals.
2. It is not known exactly when the virus may be shed.
3. 6 to 7 days.
4. *Chlamydia trachomatis*, *Ureaplasma urealyticum*, herpes simplex virus (HSV), and *Trichomonas vaginalis*.
5. 2 to 3 weeks.
6. An inflammation of the vagina.
7. Heavy foul discharge that is white, yellowish, or greenish and often frothy. Irritation of the vagina and vulva that causes soreness and itching with frequent burning during urination.
8. A sexually transmitted disease of the lymphatic system.
9. The lymph nodes in the groin swell forming a painful bubo.
10. The head louse (*Pediculus humanus capitis*), the body louse (*P. humanus corporis*), and the crab or pubic louse (*Phthirus pubis*).
11. Typhus fever, trench fever, and relapsing fever.

**215**

1. Human immunodeficiency virus (HIV).
2. T<sub>4</sub> (T-helper or CD<sub>4</sub> cells) and macrophages/monocytes.
3. By sexual contact with an infected individual or using infected intravenous injection equipment. Also an infected mother can transmit to her child before, during, and after birth (in the breast milk).
4. Homosexual and bisexual men, intravenous drug users, heterosexual partners of bisexuals or persons with HIV infection; prostitutes; and hemophiliacs who received blood prior to 1985.
5. The ELISA and the Western blot test.
6. 8 years.
7. Proper use of a condom.

**216**

1. To educate patients and to ensure that all patients and contacts are effectively treated so that complications are avoided.
2. Interviewer is knowledgeable and controls the conversation.
3. Telephone, diagrams, references, pictures, forms, worksheets, a calendar, maps, phone book, and tissues.

**217**

1. 15 to 50 days, with an average of 28 to 30 days.
2. Through contaminated food and water, milk, sliced meats, salads, and raw or undercooked mollusks or through direct contact.
3. Hepatitis B.
4. 45 to 180 days, with an average of 60 to 90 days.
5. EIA or RIA.
6. Hepatitis B.

**218**

1. Education and injections.
2. Immune globulin.
3. Injection with HBIG within 1 week of exposure.
4. HBV vaccine administered in series of three injections given over 6 months.

**219**

1. An acute disease with sudden onset of profuse watery stools, occasional vomiting, rapid dehydration, and circulatory collapse.
2. 2 to 5 hours, up to an average of 2 to 3 days.
3. Through drinking water contaminated with the protozoa.
4. Selecting water sources that are not contaminated with feces, educating the population, and treating water sources.
5. Chronic diarrhea, abdominal cramps, bloating, frequent loose and pale greasy stools, fatigue, and weight loss.
6. 3 to 25 days after exposure, with an average of 7 to 10 days.
7. An acute bacterial disease involving the large intestine.
8. Fecal-oral.

**220**

1. AFI 48-105.
2. PH.
3. Completes an AF Form 570.
4. AF Form 570.

**221**

1. Making recommendations to the MTF Infection Control Committee of laboratory tests or immunizations necessary for preemployment and routine physicals.
2. Gram-negative aerobic bacilli.
3. Infection that develops from organisms patient normally carries.
4. Structural inadequacies, contaminated devices or equipment, and practices by medical staff or other patients.
5. Control and prevent the occurrence of nosocomial infections within the hospital environment.

**222**

1. 6 to 72 hours, with an average of 12 to 36 hours.
2. Sore red throat, fever, and vomiting.
3. Nausea, abdominal cramps, headache, fever, and diarrhea which might be bloody if severe.
4. Meningitis, abortion, prenatal septicemia, permanent mental deficiency, or death.
5. Its distribution in the environment, ability to survive for long periods of time under adverse conditions, and ability to grow while under refrigeration.
6. Bacteria.
7. Nothing will destroy it.
8. Acute abdominal pain, gas, diarrhea, chills, and fever.

**223**

1. An agent, a vehicle, a susceptible consumer, and an abuse of a foodhandling procedure.
2. Immediately after interviewing patients and finding a common facility, meal, or food.
3. AFIERA/SDE.
4. AF Form 431.

**224**

1. Five.
2. Fever, headache, malaise, sore throat, and cough or abdominal pain.
3. Coma.
4. Encephalitis.
5. Euthanasia.

**225**

1. Ensuring that the biting animal has been quarantined and that the decision of whether the animal has rabies or not is answered. The veterinarian also provides information on the incidence of rabies to any healthcare provider and the Rabies Advisory Committee.
2. HRIG and HDCV.
3. Brain tissue.
4. DD Form 2341.
5. PH.
6. In the patient's medical records.

**Do the unit review exercises before going to the next unit.**

## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

25. (209) What form of meningitis, which is more common and less severe than bacterial meningitis, is normally called “aseptic meningitis”?
  - a. Viral meningitis.
  - b. Spinal meningitis.
  - c. Streptococcus pyogenes.
  - d. Haemophilus meningitis.
26. (209) What is the most common type of streptococcal infection?
  - a. Sore throat.
  - b. Scarlet fever.
  - c. Rheumatic fever.
  - d. Kidney infection.
27. (209) A major change in the antigens of influenza is referred to as
  - a. antigenic drift.
  - b. antigenic shift.
  - c. genetic evolution.
  - d. epidemic change.
28. (209) The Air Force instituted the Influenza Surveillance Program to identify new strains of influenza viruses. This program is also known as
  - a. Project Gargle.
  - b. Project Influenza.
  - c. the Disease Surveillance Program.
  - d. the Influenza Vaccination Program.
29. (210) What tuberculin skin test is used by the Air Force to screen people for tuberculosis?
  - a. Mantoux test.
  - b. Sputum culture.
  - c. Tuberculin tine test.
  - d. Bacille Calmette-Guerin.
30. (210) How long after receiving a bacille Calmette-Guerin (BCG) vaccination will most people revert to a negative tuberculin skin test?
  - a. 4 years.
  - b. 6 years.
  - c. 8 years.
  - d. 10 years.
31. (210) To confirm a diagnosis of tuberculosis, it is essential to perform a
  - a. chest X-ray.
  - b. tine skin test.
  - c. sputum culture.
  - d. Mantoux PPD skin test.

- 
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32. (210) Where is the *original* AF Form 2453, Tuberculosis Detection and Control Data, filed?
- a. Public Health patient filing system.
  - b. Patient's outpatient medical record.
  - c. County health office.
  - d. It is not necessary to file the original.
33. (211) During what period of development is syphilis first detectable through laboratory testing?
- a. Initial.
  - b. Latent stage.
  - c. Primary stage.
  - d. Incubation period.
34. (211) Which laboratory test measures antibodies to the causative organism of syphilis?
- a. Darkfield microscopy.
  - b. Lightfield microscopy.
  - c. Nontreponemal testing.
  - d. Treponemal testing.
35. (211) What are you looking at if you see a raised, table-top or mushroom-like papule with a pale, white soggy appearance on the genitals or rectum?
- a. Adenitis.
  - b. Alopecia.
  - c. Mucous patch.
  - d. Condylomata lata.
36. (211) What do you call the thinning of the scalp hair (often described as "moth eaten") during the second stage of syphilis?
- a. Condylomata lata.
  - b. Mucous patches.
  - c. Alopecia.
  - d. Adenitis.
37. (211) During which stages of syphilis should public health emphasis be placed on identifying and treating cases?
- a. Primary and secondary.
  - b. Late latent and late.
  - c. Secondary and late.
  - d. Congenital and late latent.
38. (212) Gonococcal epididymitis is an example of which type of gonorrhea?
- a. Complicated genital infection.
  - b. Uncomplicated genital infection.
  - c. Complicated nongenital infection.
  - d. Uncomplicated nongenital infection.
39. (212) What is the most common complication of female gonorrhea infections?
- a. Sterility.
  - b. Salpingitis.
  - c. Genital lesions.
  - d. Pelvic inflammatory disease.

40. (212) When a patient indicates difficulty in taking multidose medications, a health care provider may select a single-dose injection. This is an example of which consideration for treatment of gonorrhea?
- Reliability.
  - Antibiotic side effects.
  - Antibiotic effectiveness.
  - Compromised immune system.
41. (213) What is a chronic infectious disease of the conjunctiva and cornea that produces photophobia, pain, and excessive tearing?
- NGU.
  - Trachoma.
  - Ocularitis.
  - Infant conjunctivitis.
42. (213) What is considered to be the *standard* test for identifying chlamydia in genital infections?
- Cytology.
  - Skin scraping.
  - Serological testing.
  - Tissue culture.
43. (213) Which diagnostic method is the *quickest* for identifying chlamydia infections?
- Skin scraping.
  - Serological testing.
  - Tissue culture.
  - Antigen-antibody tests.
44. (214) Which diagnostic method is the most specific and sensitive to confirm herpes?
- Antigen-antibody testing.
  - Serological testing.
  - Tissue culture.
  - Skin scraping.
45. (214) What is the survival time for *Trichomonas vaginalis* in fluids outside the body?
- Zero. It dies immediately when outside the body.
  - Approximately 24 hours.
  - About 1 week.
  - Up to 2 weeks.
46. (214) What disease starts with a pimple-like sore and, if left untreated, forms a bubo in most patients?
- Herpes virus type 1.
  - Herpes virus type 2.
  - Lymphogranuloma venereum.
  - Nongonococcal urethritis (NGU).
47. (215) Which of the following symptoms does *not* assist healthcare providers in diagnosing AIDS?
- Kaposi sarcoma.
  - Cytomegalovirus retinitis (CMV).
  - Acute herpes virus type 1 infection.
  - Candida in the mouth and esophagus.

- 
- 
48. (215) Which diagnostic method is the *most specific* for identifying individuals within high-risk groups who are positive human immunodeficiency virus (HIV)?
- Tissue culture.
  - Skin scraping.
  - Western blot.
  - ELISA test.
49. (216) What method of preventing sexually transmitted diseases among sexually active people is *most effective*?
- Using condoms properly.
  - Checking partners for signs of disease.
  - Decreasing the number of sexual partners.
  - Maintaining personal hygiene after sexual contact.
50. (217) Which form of hepatitis is most commonly found in childcare centers?
- A.
  - B.
  - C.
  - D.
51. (217) Which form of hepatitis has an average incubation period of 60 to 90 days?
- A.
  - B.
  - C.
  - D.
52. (217) What must be present for the delta virus to infect and cause illness?
- Hepatitis A.
  - Hepatitis B.
  - Hepatitis C.
  - Hepatitis D.
53. (218) Who is at highest risk of hepatitis B infection?
- Child development center worker.
  - Water treatment worker.
  - Food service worker.
  - Dentist.
54. (218) What is the key to effectively controlling and preventing the spread of viral hepatitis?
- Isolate all patients with hepatitis.
  - Vaccinate all personnel for hepatitis.
  - Provide education and sanitary controls.
  - Administer immune globulin to high-risk employees.
55. (219) What is an acute disease that has sudden onset of profuse watery stools, occasional vomiting, rapid dehydration, and circulatory collapse?
- Shigellosis.
  - Giardiasis.
  - Amebiasis.
  - Cholera.

56. (219) What should be done to treat water that contains giardia cysts?
- Use routine chlorine water treatment found in communities.
  - Disinfect with three parts per million chlorine residual.
  - Disinfect with low amounts of iodine.
  - Filter with diatomaceous earth.
57. (219) What is an acute bacterial disease that involves the large intestine and has symptoms of fever, nausea, vomiting, cramps, and diarrhea?
- Cholera.
  - Amebiasis.
  - Giardiasis.
  - Shigellosis.
58. (220) Which office is responsible for preparing a list of reportable diseases?
- Public Health.
  - Patient Affairs.
  - MPF, Customer Service.
  - Infection Control Committee.
59. (220) How does a healthcare provider notify Public Health of a suspected communicable disease?
- Use e-mail.
  - Complete AF Form 422, Physical Profile.
  - Complete AF Form 570, Notification of Patient's Medical Status.
  - Fax the Standard Form 600, Chronological Record of Patient Care.
60. (221) What are Public Health's responsibilities for infection control?
- Immunizing medical treatment facility employees.
  - Providing routine physicals for medical treatment facility employees.
  - Identifying disease trends and reporting results to the infection control committee.
  - Establishing policies for medical treatment facility employees in preventing nosocomial infections.
61. (221) What is one source of *endogenous* infection for a patient in a hospital?
- Contaminated medical equipment.
  - Inadequate air-conditioning systems.
  - Poor personal hygiene of the patient.
  - Improper handling of patients by medical employees.
62. (221) Which office is responsible for maintaining proper disinfection and sterilization of hospital supplies?
- Public Health.
  - Central Supply.
  - Infection Control.
  - Bioenvironmental Engineering.
63. (222) Which foodborne illness has an average incubation time of 18 hours, and symptoms varying from nausea to severe headache, chills, fever, violent retching, colic, and diarrhea?
- Salmonellosis.
  - Campylobacter jejuni.
  - Streptococcal infections.
  - Staphylococcal intoxications.

- 
- 
64. (222) Which disease is more common than both salmonellosis and shigellosis?
- Botulism.
  - Clostridial enteritis.
  - Campylobacter enteritis.
  - Listeria monocytogenes.
65. (222) Which source is the *most common* cause of foodborne intoxication?
- Bacteria.
  - Poisonous plants.
  - Poisonous animals.
  - Chemicals used mistakenly.
66. (222) Which foodborne illness has an incubation period from 2 to 4 hours, with symptoms varying from mild nausea to projectile vomiting, cramps, and diarrhea?
- Staphylococcal intoxications.
  - Streptococcal infections.
  - Campylobacter jejuni.
  - Salmonellae.
67. (223) Who should give training on foodborne illness investigation to medical personnel who have initial patient contact?
- Public Health Services.
  - Chief, Aeromedical Services.
  - Local Public Health Department.
  - Director, Base Medical Services.
68. (223) What is a critical consideration when collecting samples for a foodborne illness outbreak investigation?
- Sampling all patients.
  - Sterility of the sample.
  - Time between collection and testing.
  - Sampling all food facilities on base.
69. (223) AF Form 431, Food Poisoning Outbreak–Individual Case History, is completed to
- list all foods served at a food facility.
  - show distribution of the disease over a period of time.
  - report the cause of disease and proper control measures.
  - list the foods consumed for 72 hours and record symptoms with onsets and duration.
70. (224) Immunizations for rabies after exposure to the disease must be given prior to the onset of encephalitis, which is in which stage of rabies?
- Stage 1. Incubation period.
  - Stage 2. Prodrome phase.
  - Stage 3. Acute neurological phase.
  - Stage 4. Coma leading to death or recovery.
71. (225) When an animal is suspected in a bite case on base, who has the responsibility for determining if the animal has rabies?
- Public Health.
  - Army veterinarian.
  - Healthcare provider.
  - Chief, Rabies Advisory Committee.

72. (225) Who reviews all cases where rabies exposure is possible?
- a. Rabies Advisory Committee members.
  - b. Chief, Aeromedical Services.
  - c. MAJCOM Public Health Officer.
  - d. Director, Base Medical Services.
73. (225) Which immunization is given to treat personnel exposed to rabies?
- a. Immune globulin.
  - b. Duck embryo vaccine.
  - c. Human diploid cell vaccine.
  - d. Animal rabies virus vaccine.

## Unit 3. Medical Entomology

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**I**N THE LAST UNIT you read about several diseases transmitted from person to person. In this unit you will read about organisms, known as vectors, that transmit disease to humans; and you will read about vector control. You will also review vectorborne diseases that affect the Air Force population and learn about your responsibilities, as well as responsibilities of other agencies, in this area.

### 3–1. Air Force Medical Entomology

Medical entomology is the study of insects that cause illness and injury. However, due to similar biologies, other arthropods, such as the arachnids (spiders, ticks and mites), centipedes, and millipedes are typically included. The Air Force medical service further expands “medical entomology” to include all animals that may harm Air Force personnel. Therefore, Air Force medical entomology often includes rats, snails, birds, and feral animals.

As the organisms that threaten our personnel are numerous and diverse, the Air Force medical entomology program relies heavily upon different agencies and individuals to prevent illness and injury. The keys to prevention are education, personal protection, and integrated pest management.

Vectorborne diseases, especially malaria and dengue, can and will stop wars in many parts of the world. Because the Air Force mission is global, arthropods and other organisms threaten airmen and the mission at hand. This section details surveillance and control of vectors and the diseases they spread, venomous organisms, and pests of food.

## **226. Functions and responsibilities**

Public health (PH) is concerned with pest/vector biology and surveillance. The civil engineers (CE) work to eliminate pests and vectors; and the bioenvironmental engineers (BEE) assure safe use, storage, and handling of pesticides. Direct patient care personnel work to eradicate the pathogen in the human population. Entomology consultants assist with technical issues; and when need be, they use aerial application of pesticides to prevent severe outbreaks of disease.

A clear understanding of the functions and responsibilities of medical entomology is vitally important. Such an understanding should grow out of your study of the goals of the medical entomology program, which are to prevent and control vectorborne diseases by eliminating disease vectors, reservoirs, blocking transmission of pathogens to susceptible hosts, and protecting susceptible hosts.

### **Base commander**

The base commander has the ultimate responsibility for ensuring proper actions are taken to protect personnel within the command from vectorborne diseases.

### **Base civil engineer**

The base civil engineer is responsible for planning, accomplishing, and coordinating vector and pest management activities. AFI 32-1053, *Pest Management Program*, outlines the pest management program for the base CE.

### **Chief, Aerospace Medicine**

The chief of aerospace medicine, oversees the medical entomology activities of both PH and BEE. AFI 48-102, *Medical Entomology Program*, outlines the Air Force's medical entomology program.

### ***Public health***

In the medical entomology program, you will survey disease vectors by using approved methods at frequencies set by the Aerospace Medicine Council. Surveying involves collecting and identifying specimens. Then, the surveillance data is compared with the historical disease incidence in the area to determine if there is potential for an outbreak to occur. You must maintain a close liaison with the federal, state, and local health agencies, including foreign and civilian public health agencies, to determine disease incidence. If surveillance data indicate that vectors or medical pests pose a health threat, interfere with duty performance, or cause a morale problem, you must recommend that CE implement control measures.

### ***Adviser***

Public health personnel advise healthcare providers on preventive measures and control requirements for the vectorborne diseases in the area. Healthcare providers may not recognize vectorborne diseases, since the symptoms are sometimes similar to those of many other diseases. Public Health also must advise healthcare providers of the threats of vectorborne disease.

### ***Educator***

Another part of your job in medical entomology is to educate personnel who deploy to areas considered at risk for vectorborne disease. You educate these people on protective measures against nuisance pests and vectorborne diseases. Also you assist in contingency site selection to minimize vectorborne disease potential.

### *Quarantine consultant*

If required, you may act as a consultant for quarantine inspections of aircraft arriving or departing when there is potential for pests or quarantinable diseases entering the United States. As a consultant, you will make recommendations concerning disinfection or disinsection of the aircraft, as necessary. If any vectorborne disease is confirmed by healthcare providers, you will inform Patient Affairs to ensure proper reporting of the disease.

### *Requester*

PH is closely involved in the aerial application of pesticides to control vectors or medically important pests. Typical PH tasks during aerial spray missions include pre- and post-treatment vector surveys to determine if the aerial spraying was effective. You might also be a member of the technical surveillance team who educates the public about the spraying or who monitors the entire spraying operation.

### *Reviewer*

Periodically, CE pest managers ask Public Health to review the activities performed by pest management personnel. The purpose for the review is to focus on pesticide use in food storage, preparation, and serving areas of food facilities, childcare centers, and medical treatment facilities to ensure patrons or patients do not become ill. DD Form 1532-1, *Pest Management Maintenance Record*, lists what pesticides were used, where they were applied, the application date, and how much was used.

### ***Bioenvironmental engineering***

The bioenvironmental engineering section (BES) provides technical information concerning the safe storage and use of pesticides. The BES monitors the acquisition, storage, and environmental impact of pesticides for the CE pest management shop, the commissary, and the base exchange facilities. BES reviews the installation integrated pest management plan, which is prepared by CE, before it is sent to MAJCOM/CE for approval.

### **Professional entomology support**

For bases in the continental United States (CONUS), vector identification, vector surveillance data interpretation, and medical entomology consultant services are provided by the medical entomologist with the Air Force Institute for Environmental, Safety and Occupational Health (ESOH) Risk Analysis (AFIERA). There also are medical entomologists assigned in PACAF and USAFE.

910 AW/757 AS/DOS, Vienna, Ohio, provides aerial pesticide spraying for bases that have been validated for aerial spraying to control vectors and common pests where vectors or pest populations have exceeded predetermined thresholds.

## **227. Taxonomy**

Taxonomy is the science of classification. You need to have a general knowledge of classifying insects to identify pests and vectors in your area. It is also important to understand formal taxonomy to communicate with others about pests and vectors. For example, some refer to the Oriental cockroach, *Blatta orientalis*, as a “water bug.” Others use “water bug” to refer to the American cockroach, *Periplaneta americana*. This issue is further complicated when we are overseas where the term “water bug” maybe entirely meaningless. However, *Blatta orientalis* refers to the same organism worldwide.

**Classification of organisms**

All living organisms are grouped into five kingdoms: bacteria (Monera), protoza and algae (Protista), fungi, plant, and animal kingdoms. Groupings or subclassifications within the kingdoms, in descending order, are phylum, class, order, family, genus, and species.

**Phylum**

A phylum is a major taxonomic unit comprised of organisms sharing a fundamental pattern or organization and presumably a common descent. The phylum Chordata, for example, contains all the animals with a backbone, including humans and other mammals, birds, reptiles, and fish. The phylum Arthropoda contains about 86 percent of all described animal species. Members of this phylum have segmented bodies, jointed appendages, and an exoskeleton. A subdivision of phylum is called a class.

**Class**

A single phylum contains many classes. To carry the example of Arthropoda (phylum) further, the classes include Insecta (insects); Arachnida (ticks, mites, spiders, and scorpions); Crustacea (crabs, shrimp, and copepods); Chilopoda (centipedes); and Diplopoda (millipedes).

**Orders**

The next subgrouping is “order.” There are many orders within each class. An example is the order Diptera (true flies).

**Families**

Within each order there may be numerous family groups that have basic similar characteristics which place an organism into a particular family. An example is the family Culicidae (mosquitoes) in the order Diptera (true flies).

**Genus**

Genus is the next step in classification, and at this point, identification is almost complete. Familiarization with this division is essential to identify a specific organism. An example is *Culex*, a genus of mosquito in the family Culicidae (mosquitoes) in the order Diptera (true flies).

**Species**

In most cases, species is the last major division in the classification system. This final identification is the most important, since habits and habitats of various species of the same genus may vary greatly, thus affecting the type of surveillance and control measures used. A species is a distinct group of animals with well defined common characteristics that produce offspring with the same characteristics. For example, *Culex pipiens* is the species name of the house mosquito. There are even subspecies groupings, which include the *Culex pipiens pipiens* (northern house mosquito). Subspecies identification is necessary when individual species vary from their normal form in structure, coloration, or habits. Other terms used in place of subspecies are “strain” or “race.”

**Structure of arthropods**

One of the main differences between humans and arthropods is in the skeleton. In insects, for example, the skin has become hardened, almost like a suit of armor, into a stiff outer skeleton known as an exoskeleton. This exoskeleton protects the internal organs from injury and serves as a framework for the attachment of muscles. By contrast, in humans, the skeleton is inside the skin and is called an endoskeleton.

The body of an insect is divided into the three main regions: head, thorax, and abdomen, as shown in figure 3-1.

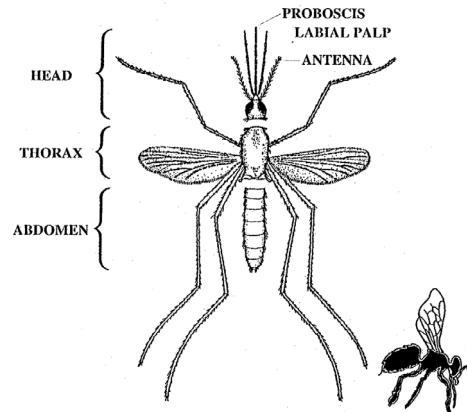


Figure 3-1. Parts of an insect.

### *Arachnida*

In the class Arachnida, usually called the arachnids, the body is composed of the two regions of the cephalothorax and the abdomen, as shown in figure 3-2.

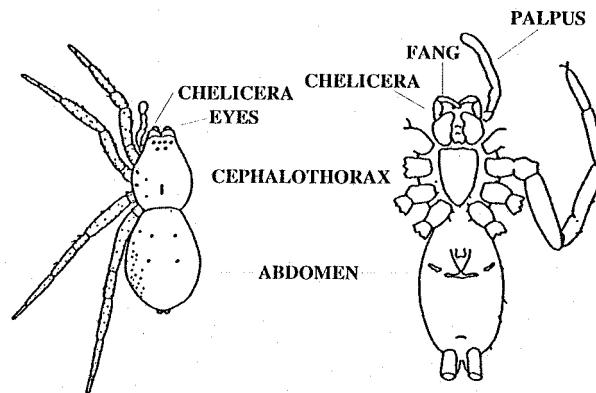


Figure 3-2. Parts of an arachnid.

### *Arachnids*

The arachnids, as you know, include scorpions, spiders, mites, and ticks.

### *Arthropods*

In most arthropods, the outer parts of the body wall are hardened or sclerotized into plates called *sclerites*, which are not flexible. These sclerites are joined by flexible portions of the body wall called *membranes*, which allow considerable movement of the exoskeleton. For example, the abdomen of a mosquito becomes greatly distended during feeding. The sclerites may be covered with many small structures, such as hairs, scales, protuberances, and spines, many of which are useful in insect identification.

### Arthropod physiology

Insect physiology deals with the functions of the various organs and systems that support the life of the insect. There are many pathogenic microorganisms that can develop inside insects if ingested. Generally, the vector's digestive system is involved since the vectors of major importance are largely bloodsucking arthropods. They suck up the disease organisms along with the host's blood and, in subsequent feedings, transfer the pathogens to other hosts. Thus, an elementary knowledge of the internal structure and physiology of arthropods is of much interest and use to public health workers.

### Arthropod development

The life cycle begins with the egg and is completed when the adult stage is reached. The term "life span" refers to the entire length of life of the insect. Some insects, such as tropical termite queens, may live for 15 to 20 years, and the periodical cicada lives for 14 to 17 years. Mayflies may live only a few days as adults, after spending 2 to 3 years in the developing, immature stages. The changing of structure and habits in animals during normal growth, usually after the egg stage, is known as "metamorphosis." This development is either through complete metamorphosis, gradual/incomplete metamorphosis, or no metamorphosis (no changes from young to adult stage). All arachnids go through gradual metamorphosis.

### Complete metamorphosis

Insects with complete metamorphosis have the four stages of egg, larva, pupa, and adult, as shown in figure 3-3. Insects with this life history are greatly different in the immature and adult stages. Typical larvae are the wrigglers of mosquitoes, the maggots of flies, or the caterpillars of butterflies and moths. The pupal stage is an important evolutionary development when the simple larva undergoes many external and internal changes to become the complete adult.

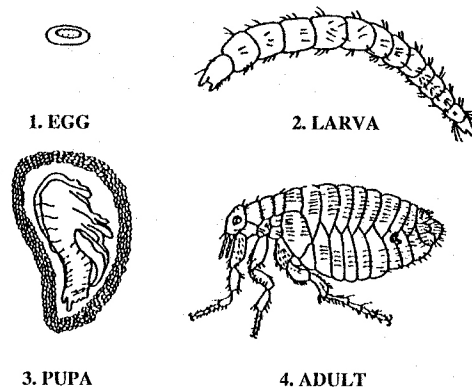


Figure 3-3. Complete metamorphosis.

### Winged and wingless

Most of the insects with complete metamorphosis have wings as adults, but some species, such as the flea, are completely wingless. Normally, the wing buds first appear in the pupal stage. However, not all insects with complete metamorphosis have pupal shells. For example, the beetle and ant do not have pupal shells even though they go through complete metamorphosis.

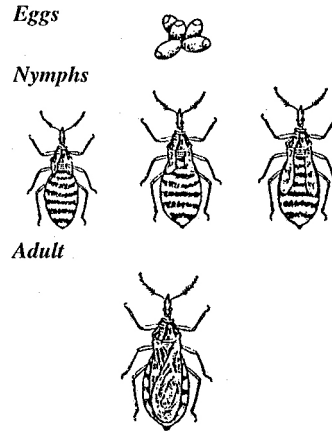
### Orders of insects

There are many orders of insects having complete metamorphosis. Five of these orders are very important to public health workers.

1. Diptera – flies, mosquitoes, midges, and punkies.
2. Siphonaptera – fleas.
3. Lepidoptera – moths, butterflies, and skippers.
4. Hymenoptera – ants, bees, and wasps.
5. Coleoptera – beetles.

### ***Incomplete metamorphosis***

Insects with gradual or incomplete metamorphosis pass through three developmental stages: egg, nymph, and adult as in figure 3–4. Insects in this group gradually go through a succession of changes to become adults. The young resemble the adult insect except for their smaller size and the absence of wings in wing-bearing species.



**Figure 3–4. Incomplete metamorphosis.**

### ***Gradual metamorphosis***

The young, or nymphs, are not sexually mature and may bear wing pads in the latter stages of their development.

### ***Important orders***

Some important orders with gradual metamorphosis include these:

- Blattaria – cockroaches.
- Anoplura – sucking lice, including crab and body lice.
- Hemiptera – true bugs, including the bed bug and kissing bug.

### ***No metamorphosis***

Insects with no metamorphosis are wingless as adults, and size is the primary difference between nymph and adult. For example, Collembola (springtails) are found in gardens, greenhouses, and mushroom cellars; Thysanura (silverfish) are found as household pests feeding on starchy material.

### **Identification of insects**

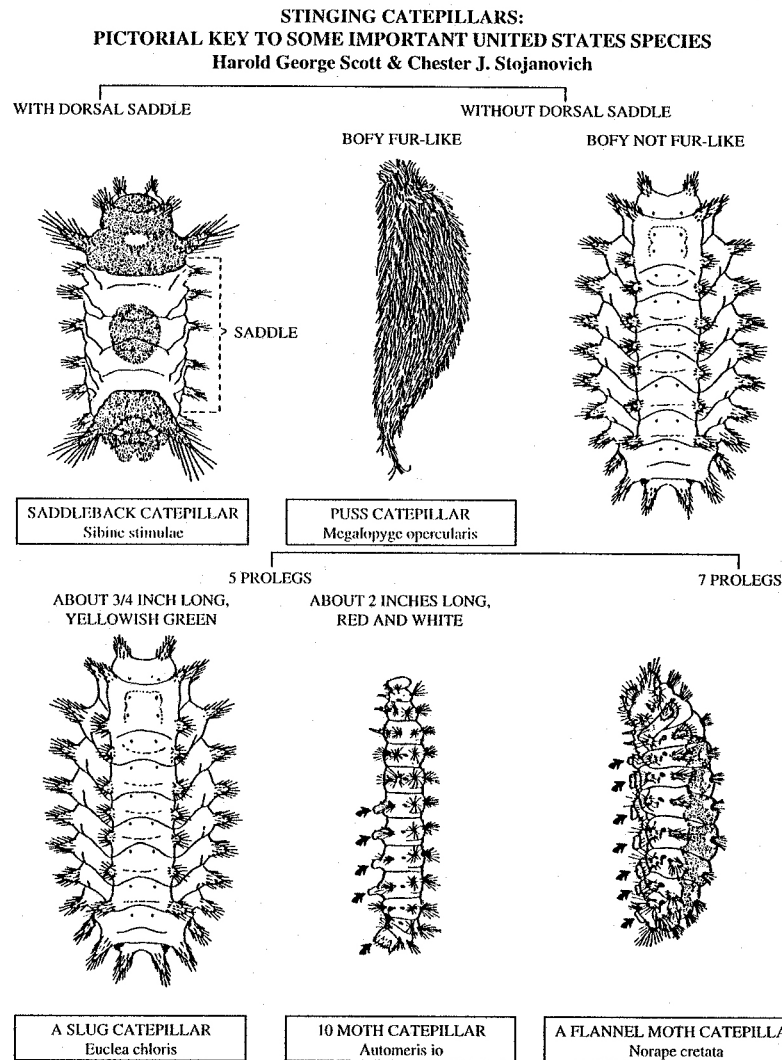
To identify an insect to order, family, genus, or species, you examine the structure of the antennae, wings, legs, and mouthparts. Frequently, very small details such as specific body hairs or scales are important. Therefore, you must keep the collected specimens in good condition for proper identification. Most large insects are identified using a hand lens or low-power dissecting microscope. However, very small insects require the use of a compound microscope.

Even though laboratories are available for pest identification, it may be necessary for you to identify a pest. The best way to identify insects is with a key. There are several types of keys, such as the pictorial and word keys illustrated below.

### ***Pictorial key***

This is a diagram-based key. See figure 3–5 for an example of a pictorial key for stinging caterpillars. The key is usually read from the top down; and the pictures are connected by lines like an organizational functional chart or chain-of-command diagram. At each line you have to make a

decision between two major identifying features. As you find each major identifying feature, you trace the line in the direction indicated by arrows to the next differentiating feature.



**Figure 3-5. A pictorial key for stinging caterpillars.**  
 (Reproduced from publication of the Department of Health and Human Services,  
 Centers for Disease Control and Prevention (CDC), Atlanta, Georgia.)

**Written key**

This is a brief description of anatomical features used to identify insects. The key is arranged in a couplet (two-statement) format, as shown in figure 3–6. Each statement includes a specific description of a body part, followed by either a name or a number. The name shows either the phylum, class, order, family, genus, or species of the specimen; the number refers you to another couplet to help you complete the identification process. You must always make a choice between the couplet statements at each step.

**KEY TO  
THE FAMILIES OF ANOPLURA  
(SUCKING LICE)**

1. *Body thickly beset with short stout spines, or with spines and scales; parasitic on marine mammals* \_\_\_\_\_ *Echinophthiriidae*
- 1'. *Body with spines or hairs, but never with scales; parasitic on land mammals* \_\_\_\_\_ 2
- 2(1') *Eyes or eye tubercles present, parasitic on man and other primates* \_\_\_\_\_ *Pediculidae*
- 2' *Eyes lacking; parasitic on mammals other than man and other primates* \_\_\_\_\_ *Haematopinida*

Figure 3–6. A written key for the families of Anoplura.

**Keys for various arthropods and rodents**

Keys for various arthropods and rodents are available from the Centers for Disease Control and Prevention, Atlanta, Georgia 30333. Also, keys are found in entomology textbooks as well as a variety of other sources.

**Key to mosquitoes**

Below is another example from a written key to mosquitoes. The couplets show how to identify two important mosquito genera - *Anopheles* and *Aedes*.

*Keys to Anopheles and Aedes Mosquito Genera*

1. Palp about as long as proboscis; wing scales of most species aggregated into dark spots; body held at angle to skin surface when biting \_\_\_\_\_ *Anopheles*  
Palp much shorter than proboscis; body held parallel to skin when biting \_\_\_\_\_ 2
2. End of abdomen pointed; postspiracular setae present \_\_\_\_\_ *Aedes*  
End of abdomen blunt; postspiracular setae absent \_\_\_\_\_ Not *Anopheles* or *Aedes*

## Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

### 226. Functions and responsibilities

1. What are the goals of the medical entomology program?
2. What instruction outlines the pest management program for the base civil engineer?
3. What instruction outlines the Air Force's Medical Entomology Program?
4. Who establishes the surveillance frequencies for disease vectors?
5. What are primary PH tasks during an aerial spray mission?
6. What form lists what pesticides were used, where they were applied, the application date, and how much was used?
7. What are the BES responsibilities in the medical entomology program?

### 227. Taxonomy of arthropods

1. What is "taxonomy"?
2. What is the next lower subdivision of a phylum?
3. What subdivision comes after order?
4. What subdivision is before genus?

5. In most cases, what is the last major division in the classification system?
6. What are the other names used in place of “subspecies”?
7. What is the stiff outer skeleton in arthropods called?
8. What are the three regions of an insect’s body?
9. What are the four stages of complete metamorphosis?
10. What is a written insect key?

### 3-2. Mosquitoes

Mosquitoes transmit diseases to millions of people worldwide each year. This is very significant since the military deploys to most parts of the world. Even the United States is affected by mosquito-borne diseases, such as encephalitis and West Nile Fever.

#### 228. Biology

The mosquito belongs to the most abundant group of invertebrate animals, the insects. They are in the class Insecta, order Diptera, family Culicidae. There is a variety of genera within the Culicidae, such as *Aedes*, *Coquilleltidia*, *Culex*, *Culiseta*, *Deinocerites*, *Haemaogogus*, *Mansonia*, *Orthopodomyia*, *Psorophora*, *Uranotaenia*, and *Wyeomyia*. Of course, there are many species within each genera.

#### Bionomics

To understand mosquitoes, you need to know the mosquito life cycle and their adult habits. The life stages of the mosquito is shown in figure 3-7.

#### Egg stage

Eggs are deposited in or near water because juvenile mosquitoes are aquatic. Mosquitoes of the genus *Culex* deposit their eggs attached together in the form of rafts that float on the water. The *Anopheles* mosquitoes deposit single eggs that have floats on the sides. *Aedes* mosquitoes deposit single eggs without any floats attached.

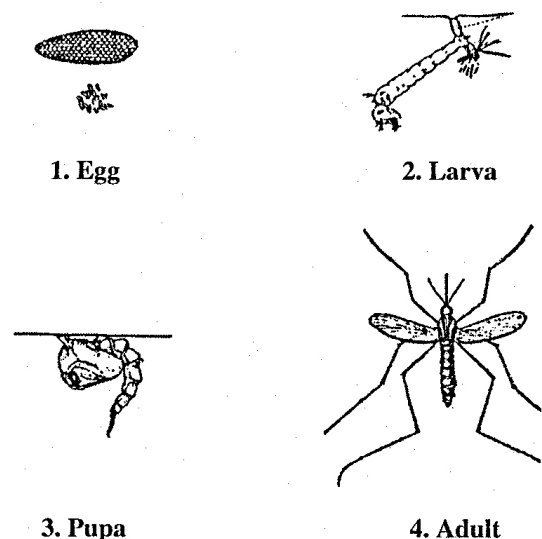


Figure 3-7. Mosquito life stages.

The mosquito eggs can develop in almost any standing body of water, except for very hot water or salt water. Eggs of some species of mosquitoes can develop in farm ponds, while others can develop in salt marshes, tree holes, tires, tin cans, sewage catch basins, or ditches. In order to maintain control over mosquitoes, it is important that you know the breeding biology of a particular vector species, because even closely related mosquitoes may have very different larval habitats.

### ***Larval stage***

The second stage of the mosquito life cycle is the larval stage (larva is singular; larvae (pronounced lar-vi) is plural). Larvae can develop only in water; and they feed on algae and organic debris. The larvae breathe air much like a dolphin or whale. However, larval mosquitoes obtain oxygen through a breathing tube at the posterior end of the body (except *Anopheles*, which breathe through a pair of holes at the posterior end of the body). The genera *Mansonia* and *Coquillettidia* obtain air by piercing the underwater portions of aquatic plants.

The position of the larvae in the water is important to identifying the genera. *Anopheles* larvae lie parallel to the water surface, while *Culex* and *Aedes* lie at an angle to the water surface. Mosquito larvae swim by undulations of the body. The average length of time in the larval stage is 4 to 10 days, depending on the species, water temperature, and food availability.

### ***Pupal stage***

This third stage is the transition stage from larva to adult. The pupae stay in the water and remain active. They do not feed during this stage, and they breathe through the trumpet-like structures on the thorax.

### ***Adult stage***

Adult mosquito populations are generally half male and half female. The males usually emerge first and remain in the area until the females emerge. You can use behavior, as well as some physical structures, to differentiate between male and female mosquitoes. Take a few minutes to study information provided in the table below and figure 3-8.

<b>Male mosquitoes</b>	Male antennae are bushy and palpi are at least as long as their mouthparts.
<b>Female mosquitoes</b>	<i>Anopheles</i> female palpi are as long as their sucking mouthparts. <i>Culicine</i> female palpi are shorter than their mouthparts. Regardless of the length of the palpi, all females have few hairs on the palpi and antennae
NOTE: Only the female mosquitoes feed on blood. Both adult females and males feed on nectar.	

HEAD APPENDAGES OF MOSQUITOES

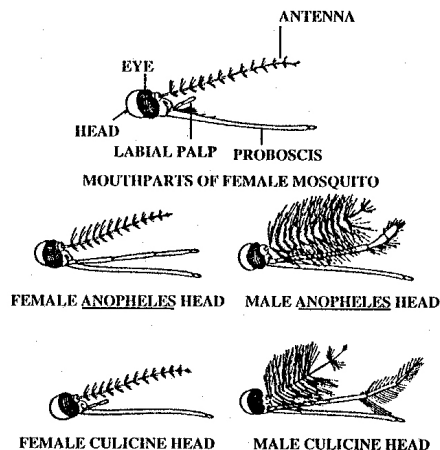


Figure 3-8. Comparison of male and female *Anopheles* and *Culicine*.

*Flight range*

Females tend to fly farther and live longer than males. The flight range varies among the different species from less than 100 meters to several kilometers. Some species increase their flight activities during a full moon. Most species are inactive during daylight hours when they rest in cool, dark, and humid places that are protected from the wind. There are some species that feed only during daylight hours. Some species can survive through the winter months and deposit eggs in the spring.

*Identify the species*

It is important to identify the species. The habits listed above will help in the identification process. Although these habits are not exact laws, they can be used as guides for generalized behavior.

**229. Mosquito-borne diseases**

Encephalitis is the most significant mosquito-borne disease in CONUS. Other important mosquito-borne diseases include dengue fever, yellow fever, and malaria.

**Encephalitis**

“Encephalitides” is the plural form of the word “encephalitis” and includes more than one encephalitic disease. Encephalitides are complex diseases that have several vectors and several reservoirs; and they can range from mild to fatal.

The mosquito-borne encephalitides are viral infections of the brain and/or spinal cord. They are often named after either the location where they were first identified or the animal they were isolated from. In CONUS, the primary vectors of encephalitis are infected *Culex* and *Aedes* mosquitoes.

The encephalitides are the most important mosquito-borne diseases in the US. There are several species of viruses that cause encephalitis:

- Saint Louis encephalitis (SLE) is found virtually everywhere in CONUS.
- Eastern equine encephalitis (EEE) occurs along the East Coast from New England to the southern tip of Texas.
- Western equine encephalitis (WEE) is found in the western two-thirds of CONUS.
- California encephalitis group (CE) includes California, Snowshoe Hare, LaCrosse, Trivittatus, Keystone, Jerry Slough, San Angelo, and Jamestown Canyon viruses, which are distributed throughout the continental United States.

The reservoirs of the encephalitides are varied; however, wild birds are the most common reservoirs of EEE and WEE. Mosquitoes cannot transmit the viruses between humans; however, certain adult female mosquitoes can transmit SLE and LaCrosse virus directly to their eggs. The offspring of these mosquitoes are then infective.

Encephalitis infections range from asymptomatic, through generalized flu-like illness, to severe central nervous (CNS) system disease that causes permanent damage or death. Specific symptoms may include fever, headaches and drowsiness, occasional vomiting, stiff neck, tremors, confusion, and convulsions. Severity varies by species of virus; for example, EEE causes the most deaths and long-lasting CNS damage. The incubation period from infective bite to sickness ranges from 2 to 20 days.

Diagnosis is by laboratory tests. Treatment is supportive. All humans without previous exposure to a given virus are susceptible to infection, but certain viruses impact certain age groups more than others.

**Dengue fever**

Dengue fever, which is a viral disease spread by mosquitoes, is found worldwide in tropical areas. Another name for this disease is “breakbone fever.”

The most common symptoms are fever; head, body, and joint aches; and pain behind the eyes. Up to half of the cases may exhibit a body rash. Classical dengue is rarely fatal. However, dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) have significant fatality rates, except in areas that have good hospital care and fluid therapy.

The vectors are certain species of the *Aedes* genus. In man, the incubation period is about 3 to 14 days, commonly 5 to 7 days. This disease is controlled through education, vector avoidance, and environmental cleanup.

**Yellow fever**

Yellow fever is a viral disease that occurs in Africa, Central and South America, and the Pacific. The virus is transmitted by *Aedes aegypti* and other mosquitoes with a mosquito-human-mosquito cycle. In the jungles, yellow fever is transmitted by a monkey-mosquito-monkey cycle, and humans are accidental hosts. Symptoms of yellow fever are fever, headache, backache, jaundice, and internal bleeding. The disease incubates in man about 3 to 6 days. Preventive measures include the administration of a highly effective vaccine and the use of individual protective measures against mosquitoes.

**Malaria**

Malaria is a public health problem today in more than 90 countries that are inhabited by 40 percent of the world’s population. Worldwide prevalence of the disease is estimated to be in the order of 300 to 500 million clinical cases each year. More than 90 percent of all malaria cases are in sub-Saharan Africa. Mortality due to malaria is estimated to be over 1 million deaths each year. The vast majority of these deaths occur among young children in Africa, especially in remote rural areas that have poor access to health services.

Malaria is a disease caused by four parasitic protozoan organisms belonging to the genus *Plasmodium*. These four species of protozoan cause four types of malaria: falciparum, vivax, malariae, and ovale. All forms of this disease are transmitted by certain *Anopheles* mosquitoes. The disease has three stages: cold stage (chills and shaking), hot stage with a high fever, and a profuse sweating stage (over the entire body). The disease attacks the patient’s red blood cells, causing anemia and an enlargement of the spleen and liver because of the pigment released from the bursting red blood cells. The capillary vessels in the brain may rupture, causing death. This is where most of the complications develop and most fatalities occur.

***Falciparum***

Falciparum malaria is found in tropical regions worldwide. It is often fatal, particularly when untreated. It takes about 10 to 16 days to incubate; and it remains infective in patients for 7 to 8 months, provided they survive the acute phase of the disease. The disease runs its course for about 1 month, and relapses do not occur. If untreated, complications affecting the brain capillaries (cerebral malaria), liver (bilious remittent fever), body temperature (reduction - called Algid malaria), and urine (turning dark red or black due to hemorrhaging called blackwater fever) can cause rapid death. Blackwater fever is extremely rare and occurs only in patients who have taken quinine as a preventive measure.

***Vivax***

This form of malaria is found in the tropics, subtropics, and temperate regions of the world. It can cause relapses for up to 5 years after the initial infection, and it is an important military threat. Although fatalities and complications are rare, it is incapacitating in an unpredictable pattern due to its relapses.

***Malariae***

This disease is relatively rare and is found in the temperate regions of the world. The disease can become chronic, lasting up to 50 years after the initial attack.

***Ovale***

This form of malaria is rare and is found mostly in West Africa. The relapses of ovale are much milder and of shorter duration than relapses of the other forms of malaria.

**Chemoprophylaxis**

Drugs are available to inhibit parasite development. The first-line drugs are chloroquine, doxycycline, mefloquine, and primaquine. Malaria in many parts of the world are resistant to chloroquine. Mefloquine and doxycycline are currently the drugs of choice. Doxycycline is most typically prescribed for flight crew, as mefloquine sometimes causes disorientation. Contact the Armed Forces Medical Intelligence Center for current information on incidence. Refer to the publications such as the CDC's Health Information for International Travel (The "Yellow Book") and the American Public Health Association's *Control of Communicable Disease in Man* Manual for recommended treatment/prevention.

**230. Surveillance methods**

The mosquito populations, and factors affecting those populations, vary from one base to another. A surveillance program on one base may not be adequate for another. You must take into account species diversity, habitat variations, climatic conditions, geographic variability, effectiveness of various survey techniques, and local control measures when developing a surveillance program.

**Installation survey**

Before establishing or revitalizing your surveillance program, conduct a baseline entomology survey of the entire installation. A base map will help you identify areas of standing or running water. You may need to survey the base and mark the poor drainage areas and wind patterns on the map. This will help you locate potential and actual breeding sites for placing mosquito traps. After you have identified breeding sources and placed your traps, indicate the site locations on your installation map as part of the permanent record of your surveillance program (fig. 3-9).

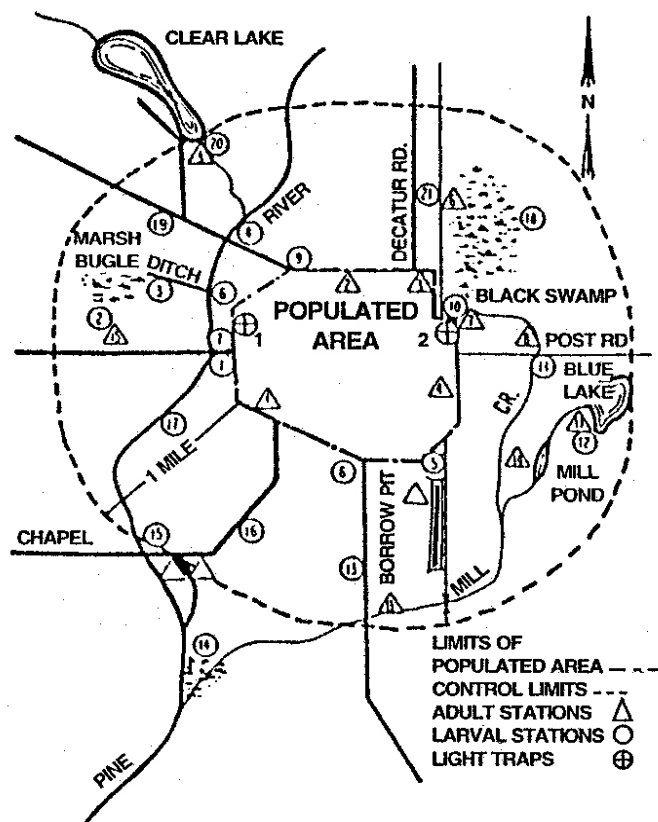


Figure 3-9. Baseline entomology surveillance map.

### Adult mosquito traps

There should be at least three traps operating at each installation, and they should be located between the populated areas (such as housing units and flightlines) and the mosquito breeding sources, or located in the populated areas themselves. However, the traps should be located away from competing light sources, and they should be protected from wind. In general, you place the traps so the light is about 6 feet above the ground to attract the most mosquitoes, and you operate them from 2 to 4 nights per week, from dusk to dawn, during the mosquito season.

Keep in mind that not all mosquitoes are attracted to light, which may affect your surveillance data. You may be incorrect if you say that a specific mosquito vector is not present at your base if you have used only light baited traps. This miscalculation could lead to an illness outbreak if the disease is present and if your statement caused relaxation of the vector control measures.

There are several different types of traps that you can use to collect adult mosquitoes, including New Jersey traps, CDC miniature traps, and solid-state Army miniature traps.

### New Jersey light trap

The New Jersey light trap (NJLT) uses either light or carbon dioxide ( $\text{CO}_2$ ), or both, to lure mosquitoes to the top of the trap, where a rotating fan pulls them down into a collection device. This collection device can be either a jar or a net. If the mosquitoes are needed alive, a net is used. However, most bases use collection jars with insecticide in the bottom of the jar to kill the mosquitoes.

A major problem with this type of trap is that it is large and needs an electrical power source, which limits its location. A 40- to 60-watt light bulb is recommended for the light source, and some of the traps have timers (fig. 3-10).

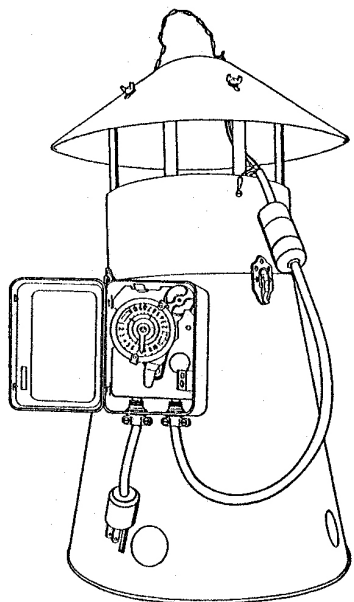


Figure 3-10. New Jersey light trap with timer.

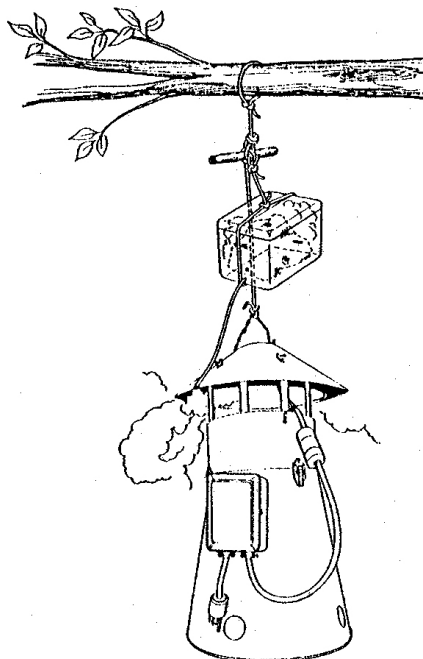


Figure 3-11. New Jersey light trap with timer and CO<sub>2</sub> conversion.

### ***CO<sub>2</sub>-baited light traps***

A standard New Jersey light trap can be converted to a CO<sub>2</sub> trap quite easily (fig. 3-11). All you have to do is remove the light bulb and connect a Tygon or rubber tube from a CO<sub>2</sub> source to the underside of the rain cover. Traps baited with CO<sub>2</sub> have several advantages over light-baited traps:

1. The CO<sub>2</sub>, which is usually in the form of dry ice, mimics the CO<sub>2</sub> of our breath as we exhale.
2. Traps baited with CO<sub>2</sub> usually attract more species of mosquitoes, larger numbers of mosquitoes, and fewer trash insects.
3. The traps baited with CO<sub>2</sub> attract fewer male mosquitoes.

There are two methods you can use to supply CO<sub>2</sub> to this type of trap. Under field conditions, the easiest way is to place blocks of dry ice into insulated containers that are connected to a tube that leads to the trap, and hang the containers in a tree near the top of the trap. The containers may be styrofoam shipping containers or newspaper wrapping. (NOTE: If you use dry ice and operate the trap 24 hours, you may need to replace the ice every 12 hours.) You can also get CO<sub>2</sub> from gas cylinders, if they're available. While cylinders are not easy to transport, they permit you to easily regulate and monitor the CO<sub>2</sub> output. If you use gas cylinders to provide the CO<sub>2</sub>, run them at 250 ml/min; this rate will produce the amount of CO<sub>2</sub> needed to attract mosquitoes.

The CO<sub>2</sub>-baited traps are operated on the same schedule as the light-baited traps. However, you also can operate the CO<sub>2</sub> traps during the daytime to catch species that are active in the late morning and early evening. A combination of light and CO<sub>2</sub> in the same trap will supplement your surveillance program and ensure that more species are attracted. Also, try to be consistent with the source and amount of CO<sub>2</sub> in the traps.

### ***Solid-state Army miniature traps (SSAM)***

The United States Army Medical and Biological Research and Development Center at Ft. Detrick developed a miniature light trap to replace the CDC trap in the federal supply system (fig. 3-12). The key features of this type of trap are portability, rechargeable gel cell battery, photoelectric switch, and the option of using D-cell flashlight batteries.

### ***Resting site collection boxes***

Many mosquitoes are active only at night, and rest in dark, quiet places during the day. Resting places include animal burrows, privies, drainpipes, old tires, empty flower pots, tree holes, culverts, and sheltered areas under bridges. You can construct artificial resting sites from a 12-inch wooden box. Paint the box red on the inside, and place it near bushes, forests, swamps, or similar areas to collect adult mosquitoes. Since most resting areas are dark, use a flashlight and battery-powered aspirator when you're collecting the mosquitoes (fig. 3-13).

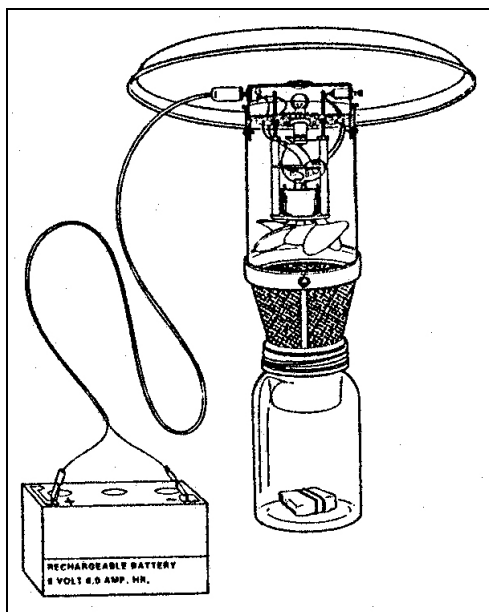


Figure 3-12. Miniature light trap.

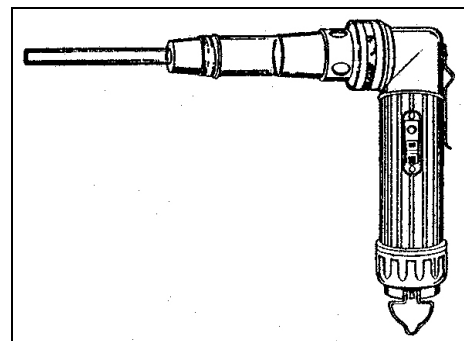


Figure 3-13. Mosquito aspirator.

### ***Larval collection traps***

You can collect mosquito larvae from sites, such as tree holes, artificial containers, catch basins, temporary pools, roadside ditches, ponds, swamps, and marshes. Although most larval collecting is done in ditches and ponds with a white dipper, you can use a large bulb pipette, such as a turkey baster, to sample water containers, such as tree holes, that have small openings. After you identify the breeding sites, mark them on the base map. Generally, you would sample these areas at least weekly. However, the frequency of sample-taking depends on the base location and the area environment.

The larval survey shows the exact breeding areas and where control is needed. However, you should analyze both the adult survey and the larval survey to determine if the adults are breeding on base or are flying in from someplace off base.

### Ovitrap

The ovitrap was developed primarily to collect the eggs of two species of mosquitoes—*Aedes aegypti* and *Aedes albopictus*. These species potentially can transmit dengue fever and yellow fever. Light traps most likely will not attract either of these species, because the female *Aedes aegypti* mosquito prefers to lay her eggs inside small dark containers. This led the U.S. Public Health Service to develop the ovitrap as a surveillance tool.

To make an ovitrap take either a 1-pint widemouth jar painted black on the outside (or a black plastic jar) and fill it about half-way with water (fig. 3-14). Wrap the lower half of a tongue depressor with a paper towel and secure the towel with rubber bands. Use a paper clip to fasten the wrapped tongue depressor to the side of the jar. Make sure the paddle is down in the water, because the mosquitoes lay their eggs on the paper towel right at the water line.

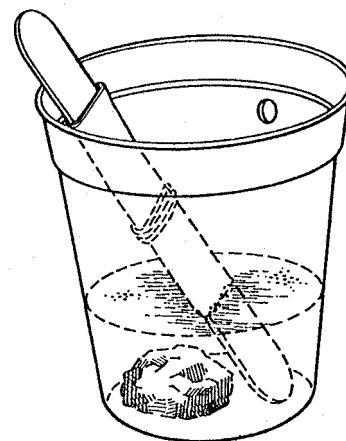


Figure 3-14. Ovitrap.

To survey your base, place ovitraps at ground level in sheltered, dark areas near houses and in tire and equipment storage yards (figs. 3-15 and 3-16). Horse stable areas also are good locations (lots of blood sources), as are locations near breeding sites (fig. 3-17). You may want to use about 10 traps and rotate them in different areas for one to two weeks at a time. Whatever you decide to do, be sure to document the location of the ovitraps on your base map and check them weekly.

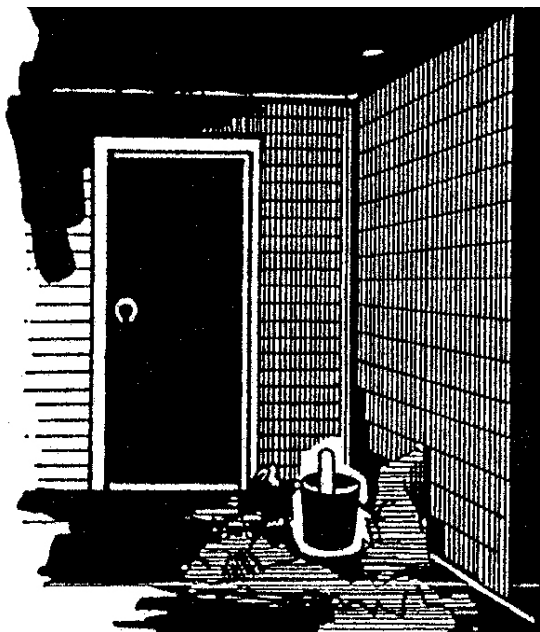


Figure 3-15. Ovitrap placement.

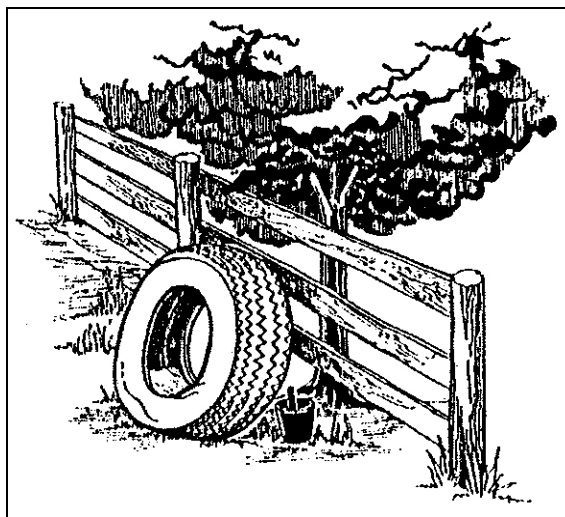
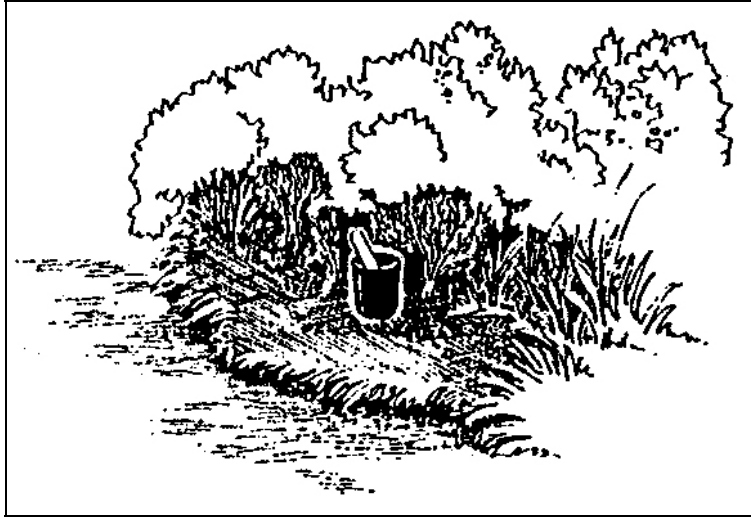


Figure 3-16. Ovitrap placement alternative site A, near a tire.



**Figure 3-17. Ovitrap placement alternative site B, a secluded possible breeding site.**

When checking the traps, remove the paddles and examine them for eggs. Also, check the water for early larvae. Send the paddles and attached eggs to the Air Force Institute for Environmental, Safety and Occupational Health (ESOH) Risk Analysis (AFIERA), Brooks AFB, Texas, for identification since many species may develop in one trap. Then, wash out the jars and add fresh water and new paddles.

A “positive” ovitrap should stimulate a search to find and eliminate the source of the detected mosquitoes. Your search can be limited to within a few blocks of the ovitrap since *Aedes aegypti* is a weak flier and rarely flies more than 100 yards from its breeding site.

### **Packing and shipping specimens**

It is very important that you properly pack specimens before shipping them to AFIERA. Pack and ship all specimens in accordance with the instructions in figure 3-18.

Improper packaging and shipping could hinder fast, accurate identifications. Some specific problems encountered include the following:

1. Damaged specimens caused by crowding or improper packaging — specimens should not touch each other.
2. Stale or old specimens that have been held for more than 3 days prior to shipping.
3. Male mosquitoes and other unnecessary insects included with the female mosquito specimens.
4. Incomplete collection information on container labels.
5. Incorrect address on shipping container.

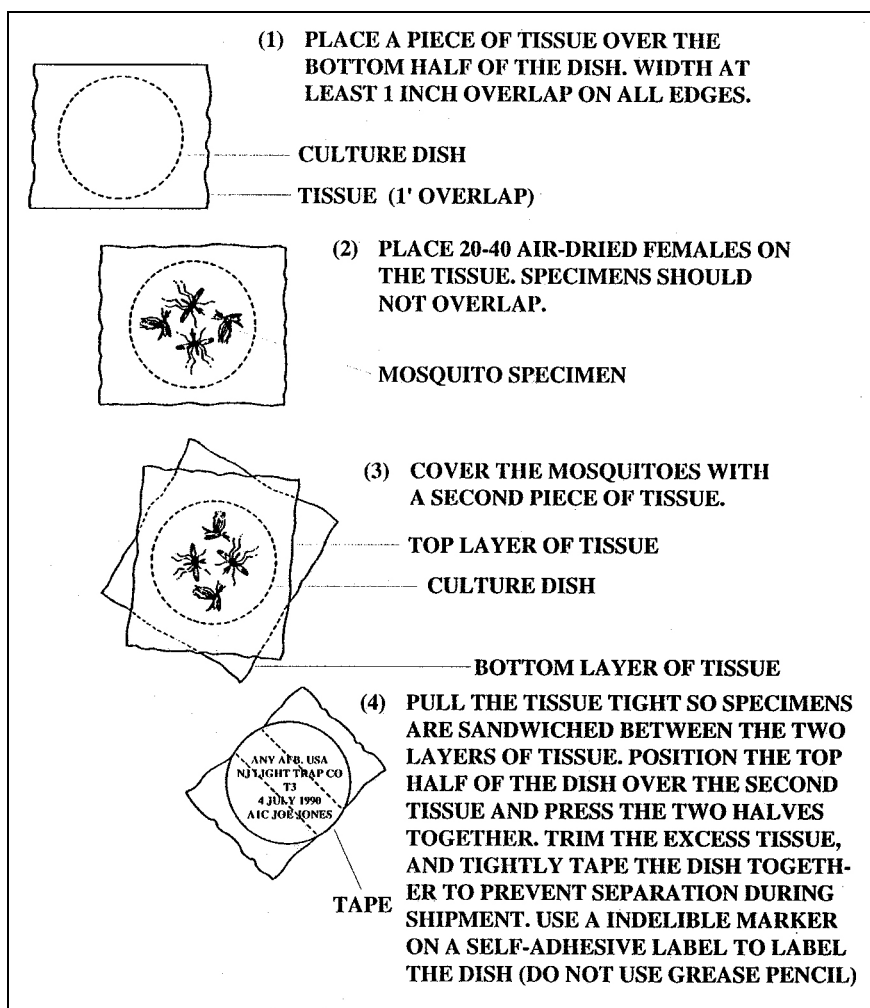


Figure 3-18. Procedures for packing and shipping specimens.

### Using surveillance data

The three primary goals of your mosquito surveillance program are to detect and monitor pest and vector species in the populated areas of the base and to help CE Pest Management personnel manage mosquito control programs. Surveillance data generated from trapping can help you to predict peak periods of mosquito abundance and to evaluate control measures. Also, it is very important that you inform CE pest management personnel of the numbers found and give them the identification information as soon as it is available.

### Trap index (TI)

The TI helps you to organize trap data and compare different time periods or locations. The TI is simply the average number of females caught per trap night. (NOTE: One trap night equals one trap operated for one night. Do not include data from malfunctioning traps in your calculations.)

The formula for computing a TI for a given time interval:

$$TI = \frac{\text{Total number of females trapped}}{\text{Total number of trap nights}}$$

Assume that an USAF installation operated four light traps for three nights during the first week in August to collect female mosquitoes. The table below indicates which traps were used and how many female mosquitoes were collected in each trap each night.

Date	Trap number	Number of female mosquitoes
<b>2 Aug</b>	1	8
	2	24
	3 <sup>a</sup>	0
	4	13
<b>4 Aug</b>	1	6
	2	30
	3 <sup>b</sup>	9
	4	0
<b>5 Aug</b>	1	11
	2 <sup>c</sup>	5 <sup>c</sup>
	3	5
	4	11

**TABLE NOTES:**

<sup>a</sup> Although it did not collect any female mosquitoes, the trap was operating and should be included in the trap-night count.

<sup>b</sup> The trap was inoperative and should be subtracted from the trap-night count.

<sup>c</sup> The trap malfunctioned; female trap-night specimens collected before the malfunction should not to be included in the total number collected. However, specimens should be submitted for identification.

Calculate the weekly TI as follows:

$$TI = \frac{8 + 24 + 0 + 13 + 6 + 30 + 0 + 11 + 5 + 11}{(4 \text{ traps} \times 3 \text{ nights}) - 2 \text{ bad traps}} = \frac{108}{10} = 10.8$$

***Specific trap index (STI)***

To show the average population of a single species or particular group of mosquitoes you would use another type of trap index called the specific trap index (STI). This type of index is particularly useful to plot fluctuations in local pest species or disease vectors.

For example, you need to know the average number of female *Aedes vexans* trapped in one week. The species index for *Aedes vexans*, which is primarily a pest species, would be calculated as follows:

$$STI = \frac{\text{Number of female } Ae. \text{ vexans trapped in 1 week}}{\text{Total trap nights for that week}}$$

### ***Graphs***

As you calculate the weekly TIs, plot them on a graph for a visual picture of population fluctuations. From these weekly graphs, you can prepare annual graphs to identify and predict peak periods of mosquito activity. In addition, TI graphs are valuable when planning mosquito control. One note of caution: Be sure to document on the graphs any reasons for fluctuations in TIs, such as abnormal weather, aerial spraying, or lack of CO<sub>2</sub> for the week.

## **231. Mosquito control measures**

There are three common types of mosquito control: cultural (or environmental), chemical, and biological. As a general rule, the preferred method is cultural control to eliminate water so the mosquitoes have no place to breed. Chemical control measures, on the other hand, are usually fast acting, temporary in nature, and aimed at killing only the adult and larval mosquitoes. Biological control methods are not as well developed as chemical or environmental methods; however, future control practices will probably lean more and more toward the biological methods.

### **Cultural controls**

Cultural or environmental methods for mosquito control are often quite expensive, initially. However, since cultural controls are usually less expensive in the long run, recommend them whenever and wherever possible. Of course you must keep in mind that the Air Force operates on a strict year-to-year budget, and you sometimes must abandon plans for environmental control methods in favor of less expensive control methods.

### ***Fill the holes***

One of the best methods of environmental control is to fill low-lying areas that contain water with gravel and dirt to eliminate breeding sites. This usually requires heavy equipment, and is the responsibility of CE. The medical service is responsible only for recommending areas for filling and monitoring the work to ensure that filling the area does not create additional problems.

### ***Control drainage***

Properly controlling water drainage also prevents mosquito breeding. However, this requires more maintenance than filling alone and should be considered only when filling is unfeasible. Draining and ditching are often used with filling, especially in irrigated areas where water flow can cause temporary ponds in low-lying areas. Draining and ditching are also frequently used in salt-marsh areas. Ditches there are designed to take advantage of tides to periodically flood and drain breeding areas. Underground drains might be necessary in marshes and swamps. This is appropriate where the soil is impervious and does not allow water to pass to lower areas.

### ***Other controls***

There is a wide variety of other environmental controls that include filling tree holes; removing cans, bottles, tires, and other receptacles that hold water; using flood gates across small streams; and screening windows and doors with fine mesh screen.

The standard issue 16-mesh-to-the-inch screening meets the requirements for mosquito exclusion; however, 24-mesh screen is necessary to exclude some of the smaller insect species. Complaints that mosquitoes are coming in through the screen are usually the result of holes in the screens or improperly installed doors and windows, rather than the size of the screening itself. A close inspection of the openings usually reveals the need to change doors, patch screens, or replace weather stripping.

**Chemical controls**

As you read in the introduction to this lesson, chemical control measures for mosquitoes are only temporary. Chemical control requires application at frequent intervals during the breeding season. You should recommend chemical control methods be used only in conjunction with environmental controls that are directed at adult and larvae populations.

***Control mosquito larvae***

Chemicals used to control mosquito larvae are called “larvicides.” They work primarily by poisoning the larvae or by a combination of poisoning and suffocating the larvae. Larvicides do not greatly affect eggs, unless they become coated with oil; nor do larvicides affect pupae, unless the air supply is eliminated.

***Dust form***

Larvicides can come in the form of dusts that allow larva to feed on the particles of insecticides. Because of their particulate nature, dusts do not distribute evenly on the water surface. They tend to accumulate in certain areas through wave and wind action. Although dust particles may be harmful to fish, they do not generally affect the plant life in the water. If applied among emergent vegetation around the edges of ponds, dusts will remain for a considerable length of time. Dusts are also used as a pre-hatch treatment applied to frozen ponds or snow-covered low spots that become temporary pools in the spring. Thus, an insecticide is present when over-wintering eggs hatch and mosquitoes, therefore, are controlled early.

***Granular form***

Another form of larvicide, the granular larvicides, have come into widespread use. They are quite effective because they dissolve slowly and distribute through the water in the area.

***Control adult mosquitoes***

There are two methods for chemical control of adult mosquitoes: (1) application of insecticide to surfaces where mosquitoes rest, which is referred to as a “residual treatment” or (2) direct application of very fine insecticide droplets into the airspace where mosquitoes fly, which is referred to as a “space treatment.”

***Residual treatment***

Interior walls and exterior surfaces of buildings can be treated with residual pesticides to control adult mosquitoes, but this method is seldom used in the more developed countries. It is very common in less developed countries. If residual sprays are applied in the form of oil solutions or water emulsions, the insecticide will remain in crystalline form after the liquid evaporates.

***Space treatment***

Aerosol bombs or aerosols give good coverage for controlling mosquitoes indoors. Outdoor space spraying requires the use of fogging or ultra-low-volume (ULV) machines. Although outdoor space spraying kills adult mosquitoes quickly, there is no residual effect. ULV adulticiding uses low amounts of pesticide to kill adult mosquitoes without adversely affecting other insect populations. ULV application is more ecologically sound and kills by body contact of the mosquito with the pesticide droplets. Ground applied ULV is the most common method.

Aerial ULV adulticiding is used when all else fails to control mosquitoes or when there is an imminent threat of mosquito-borne disease. When the adult mosquito population is very large, spraying from aircraft can give rapid control over a large area in a short time. Aerial spraying uses space-spraying techniques and requires specialized aircraft not usually available on all bases. Proposed aerial spray projects must be validated and approved in advance in accordance with DOD guidance.

**Biological control**

Biological control methods reduce the mosquito population through predators, parasites, or disease.

***Predators***

There are many natural predators, such as larvae of various insects (notably immature dragonflies) and fish) that feed on mosquito larvae. Generally speaking, it is not practical to stock an area with dragonflies; but if a large supply is present, efforts should be made not to hinder them. Protection of adult predators leads to the production of more young dragonflies; and both adult and young dragonflies feed on adult mosquitoes.

One of the most widely used predators is a small top-feeding minnow known as *Gambusia affinis*. This fresh water minnow will feed on larvae along the shallow edges of streams. *Fundulus species* serve the same purpose in salt water. Another predator is the *Tilapia mossambica*, as well as other members of the *Tilapia* species. Stocking waters with exotic fish requires approval of federal and local wildlife and fishery agencies.

***Disease***

For an example of disease vector control, *Bacillus thuringiensis israeliensis* (BTI) is a mosquito pathogen. It is applied in a solid form that dissolves in the body of water suspected to be a breeding ground and kills the mosquito larvae. It also can be used to control some species of black flies. It is a successful biological control agent at many bases.

**Integrated pest management**

Integrated pest management (IPM) is a combination of control techniques to prevent, eliminate, or suppress pests.

***Objective of IPM***

One objective of IPM is to reduce reliance on pesticides and to keep their use as the sole source of control to a minimum. A good IPM program uses pesticides only when necessary so that environmental impact, likelihood of resistance, and expenses are all minimized.

***Principles of IPM***

Applying IPM principles to the chemical control of mosquito pests means that the decision to use pesticides is not based upon some fixed prophylactic schedule, but rather upon sound data generated from a good larval and adult surveillance program.

***Procedures of IPM***

Control procedures used in a sound IPM program for mosquitoes should include the following procedures:

1. Source reduction to reduce or eliminate mosquito breeding using environmental control.
2. Protective devices, such as repellents, bed nets, and screens, to decrease contact with biting mosquitoes.
3. Biocontrol agents such as *Gambusia affinis* and pathogens such as *Bacillus thuringiensis israeliensis* to reduce immature populations.
4. Larvicide at known breeding areas with an EPA approved insecticide when necessary.
5. Ultra-low-volume (ULV) adulticide with an EPA approved insecticide when necessary.

***IMP for mosquitoes***

The best form of overall mosquito control is killing the mosquito larvae or removing their breeding areas. However, for immediate control of malaria, it is more effective to attack the adult mosquitoes directly. This is because adult mosquitoes already may have fed on a source and may be able to transmit the disease. Thus, killing the larvae will not reduce the danger of immediate infection.

*Spraying adult mosquitoes*

The best known method of killing adult mosquitoes is with residual sprays. The system used in the United States during World War II, and presently used in many parts of the world, is based on this type of control. Teams of trained personnel spray a residual pesticide on walls of houses in an infested area. The *Anopheles* mosquito usually rests on the wall for a few moments, then feeds on a human being, returns to the wall to rest again, and then departs. It is during the periods of resting on the wall, that control is effected. Even if the mosquito does reach the source of infection, death will usually result before sufficient time has passed for parasite development within the mosquito body to the infective stage.

*Repeated surveys and spraying*

The spray campaign must be repeated after the pesticide is no longer effective. After this, a survey is carried out to determine if small areas of infection still remain. These small areas of infection are then attacked with the same control measures. These measures are important and should be applied, if possible, to a combat area of fighting troops. In most cases, the best system is based on adult mosquito control, frequently with the use of spray aircraft, to kill as many adults as possible in a short time.

*Protection of hosts*

Along with such measures, the susceptible hosts must be protected from attack by parasites and infective mosquitoes. This is usually done by use of suppressive drugs and personal protective devices and repellents. During wartime, native dwellings in the vicinity of airbases and other troop concentrations could possibly be treated with residual spray. In peacetime, any such activity must be coordinated through local health departments.

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### Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

**228. Biology**

1. What genus of mosquito deposits its eggs attached together to form rafts that float on water?
2. Where do mosquito larvae develop?
3. What percentage of mosquitoes are male?
4. What sex of mosquito has bushy antennae?

**229. Mosquito-borne diseases**

1. What are the two primary vectors of encephalitis in CONUS?
2. What species of arboviral encephalitis is found virtually everywhere in CONUS?
3. Which encephalitis group includes California, LaCrosse, and Jamestown Canyon viruses?
4. What are thought to be the reservoirs of EEE and WEE?
5. What is another name for dengue fever?
6. What genus of mosquito transmits dengue fever?
7. What are the three control measures for dengue fever?
8. What are the symptoms of yellow fever?
9. What are the four types of malaria?
10. What are the three stages of malaria?
11. What is the incubation period for falciparum malaria?
12. What form of malaria is most lethal?

13. What forms of malaria have relapses?
14. What chemoprophylaxis for malaria is typically prescribed for flight crew?

**230. Surveillance methods**

1. What should you accomplish prior to establishing or revitalizing your surveillance program?
2. What are the important things to remember when locating the adult mosquito traps on base?
3. What device is used to collect live specimens in adult mosquito traps?
4. What does the New Jersey trap use to attract mosquitoes?
5. What are the advantages of a CO<sub>2</sub>-baited trap over a light-baited New Jersey trap?
6. Why would you operate a CO<sub>2</sub> baited trap during daylight hours?
7. Generally, when should you sample larval mosquito collection sites?
8. What two mosquito species are collected primarily through the use of an ovitrap?
9. What is a TI?
10. What is an STI?

### 231. Mosquito control measures

1. What are the three types of mosquito control?
2. What is one of the best methods of cultural control?
3. What are the two methods of chemical control used on adult mosquitoes?
4. What predator is most widely used for feeding on mosquito larvae?
5. What disease is most widely used to control mosquito larvae?
6. What is “integrated pest management”?
7. What is the best overall method of adult mosquito control?

## 3-3. Other Arthropods

In addition to mosquitoes, there are many other arthropods that may be involved in disease transmission. Some of the primary ones are lice, flies, fleas, ticks, and mites. Additionally, venomous arthropods can cause illness in humans.

### 232. Lice

All human lice are small, flat, and wingless. They all have incomplete metamorphosis: egg to nymph (young louse) to adult stage. Body lice and head lice are anatomically similar (fig. 3-19).

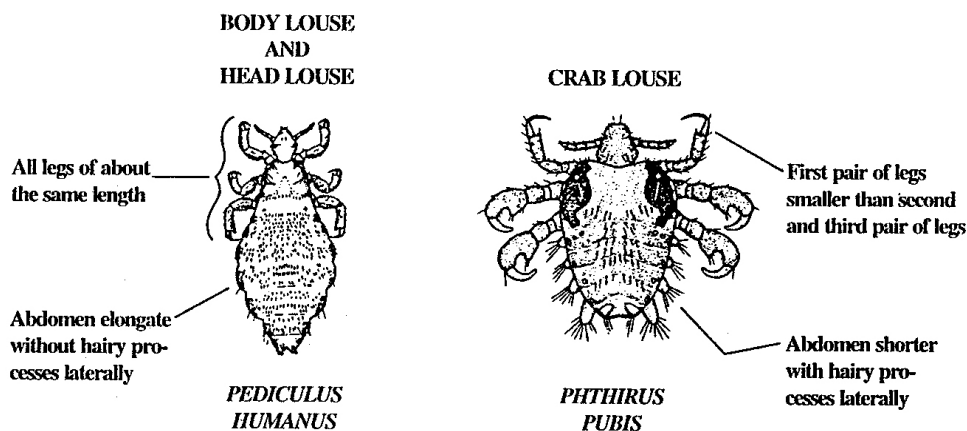


Figure 3-19. Human lice.  
(Reproduced from publication of the Department of Health and Human Services,  
Centers for Disease Control and Prevention (CDC), Atlanta, Georgia.)

There are three distinct varieties of lice that infect humans: *Pediculus humanus capitis* (head lice), *P. humanus humanus* (body lice), and *Phthirus pubis* (crab or pubic lice). Head lice and crab lice attach themselves to the hair shafts of humans to remain close to their blood supply; body lice are found in the host's clothing except while feeding, which they do approximately five times a day.

### **Habitats of human lice**

Human lice are found all over the world. They thrive during famines, wars, and among people suffering economic hardships. Whenever large groups of people are deprived of homes, clothing, and bathing facilities, lice usually appear.

Human lice are particularly associated with cold weather. Although lice are present in the higher altitudes of the tropics, they are found more commonly in temperate and subarctic areas where people wear heavy clothing in several layers.

### **Diseases caused by human lice**

Diseases transmitted by body lice have always been a threat to the fighting forces. Wars have been lost as a result of casualties caused by louse-borne diseases. There is no evidence that head and pubic lice are disease vectors, although they can be severe pests.

The louse-borne diseases are epidemic typhus, relapsing fever, and trench fever. Of these, epidemic typhus is the most important.

- Relapsing fever is usually present wherever epidemic typhus occurs. Cases occurred among American troops in World War II and in the Korean War.
- Trench fever was very common among European armies during World War I, but has greatly declined since then.

All of these diseases, which are spread from human to human by body lice, may occur in epidemics. Since they are serious infections, they are a special threat to armies.

Pathogens for typhus and trench fever are not transmitted by the actual bite of a louse. The germs contained in the gut of the louse are passed out with the droppings of the louse when it feeds. Louse bites itch and cause scratching, during which the germ-laden feces are rubbed into the tiny skin abrasions. Scratching also may crush the louse and rub the germs it contains into the wound, which is how relapsing fever is transmitted. Pathogens are also transmitted through contact of contaminated fingers with mucous membranes or the conjunctiva.

Relapsing fever spirochetes are transmitted from crushed lice. When the lice bite, scratching crushes the lice and the fingers then rub the crushed pieces into the wound or into mucous membranes or conjunctiva. The spirochetes are not found in the feces of the lice.

### **IPM for lice**

With all forms of louse control, education of the people is the most effective method of prevention. It is equally important to educate people on what is not effective. You can use cultural control, chemical control, and mechanical control measures against lice. However, the methods of control differ based on the habits of the individual species.

#### ***Cultural control***

Head lice can be controlled by avoiding contact with other people's headgear, combs, brushes, etc. Also, individuals should shampoo often.

The best control for body lice is personal cleanliness. If people take frequent baths and change clothes regularly, lice can be kept under control. People should avoid contact with other people who are infested with lice and infected people's clothing and bedding. Infested clothing and bedding should be washed in hot, soapy water — water should be at least 140°F. If clothing cannot be washed, dry cleaning is also effective.

Pubic lice can be controlled by avoiding sexual and other body contact with infected people and their clothing. Wash clothing and bedding in hot water.

### ***Chemical control***

Head lice can be treated with insecticidal shampoos, lotions, creams, or dusts. Area insecticidal control is useless for head lice.

For body lice, treat infested clothing or bedding with insecticides. In the case of a threatened or actual epidemic typhus outbreak, dust the clothing while it's on the body of the person. Area insecticidal control is useless for body lice.

Treat pubic lice with insecticidal shampoos, lotions, creams, or dusts. Area insecticidal control is useless for this species of lice also.

### ***Mechanical control***

For head lice, remove nits and lice with a nit comb, or by hand. Note, however, that removing them by hand is not particularly effective.

Manual removal of body lice from clothing and bedding is not particularly effective.

Manual removal of pubic lice from affected areas is not particularly effective either.

## **233. Flies**

The most common type of fly is the house fly. The house fly, and flies with similar habits, are often called "domestic species" because of their close association with people. The adult houseflies feed on human food, but they and their larvae are often most abundant in excrement, garbage, and open dumps.

Most flies are pests both indoors and out. They have complete metamorphosis with four stages in their life cycle: egg, larva (called maggots in some species), pupa, and adult. Although there are many fly species that cause concern for public health officials, only a few are introduced here.

### **Categories of flies**

There are two major categories of flies:

1. Biting flies spread disease agents through their bites into animal blood sources. Some of the flies in the category of biting flies are stable flies, sand flies, black flies, midges, a variety of gnats, and deerflies.
2. Filth flies got their name because they breed in excrement and filth from which they carry disease-causing organisms to food, drinking water, or the human body. In the filth fly category there are dump flies, fruit flies, flesh flies, a wide variety of bottle flies, and house flies.

### **Diseases spread by flies**

Throughout the world, flies are mechanical and biological carriers of organisms that cause some of the most common and important diseases, such as typhoid fever, diarrhea, dysentery, and cholera. Many types of flies, particularly the housefly and other domestic flies, have filthy habits that make them efficient vectors of disease. In the tropics, various skin and eye diseases are spread by flies. Biting flies transmit onchocerciasis, leishmaniasis, and trypanosomiasis.

Flies spread pathogens in five ways: on or by their mouthparts (sloppy eating or blood sucking), through their vomitus (used to dissolve solid foods), on their body hairs, on the sticky pads of their feet, and through their feces.

*Myiasis* is the condition in which a living human is infested with maggots. This condition can result in irritation or even a fatality depending on the species, number of maggots, and human body part involved. Certain flies, like the screw worm, may cause significant damage; others, such as the human bot fly of South America, may simply cause painful boil-like infestations. Injured personnel and invalids must be protected from fly exposure, as they may have open wounds and be unable to prevent fly contact.

### **IPM for flies**

Proper sanitation to eliminate breeding places is the most effective fly control measure. Also screening of living quarters and use of chemicals to kill both adults and larvae are effective in controlling the fly population.

### **Cultural control**

Remove all garbage, manure, carrion, and other materials where flies spend their larval stage and feed in their adult stage. Most of the fly problem will then go away.

### **Chemical control**

Use residual insecticides on surfaces where flies land and space sprays where flies are flying. Bait that has been formulated to attract flies is particularly effective.

### **Mechanical control**

Use screens, nets, and other exclusion devices. "Air curtains," although common, are of questionable value.

## **234. Fleas**

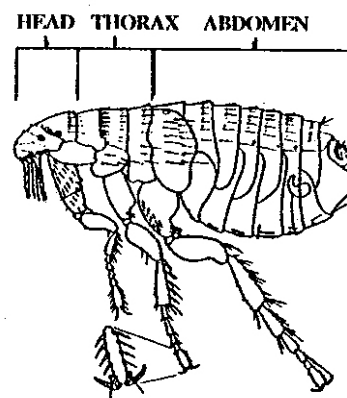
Fleas are small wingless insects of the order Siphonaptera. As the order name indicates, these insects feed through a siphon (or tube) and have no wings (fig. 3-20). This species includes the oriental rat flea, human flea, northern rat flea, dog and cat fleas, and the sticktight flea. Both male and female fleas in this order feed on blood; and the female must have a blood meal to produce eggs.

### **Diseases spread by fleas**

Fleas are responsible for the transmission of plague and endemic typhus (murine typhus). Various rodents, principally rats and ground squirrels, are sources of infection from which fleas pick up the disease germs and transmit them to humans. When the normal rodent hosts are unavailable, rodent fleas will readily attack humans. Fleas, such as the Chigoe flea (or jigger), attack bare feet, usually between the toes and on the soles, which causes painful swelling and inflammation.

### **Transmission of disease**

Fleas become infected with plague germs when they feed on a rodent with plague. Plague is then transmitted to humans through the bite of the infected flea. Humans also can become infected with plague when they breathe plague germs coughed from the lungs of a person or cat with pneumonic plague, or through blood-to-blood contact with an infected animal. Endemic typhus (murine typhus) is transmitted when flea feces or crushed fleas are scratched into an open wound in the skin, which could occur when someone scratches a flea bite.



**Figure 3-20. Flea.**

### IPM for fleas

As with other pests there are three forms of control that can be used against fleas: cultural, chemical, and mechanical.

#### *Control measures indoors*

Indoors you can use both cultural and chemical controls.

##### *Cultural*

Vacuum all rugs and floors several times each week. Also, vacuum the heating and air conditioning ducts periodically. Wash pet bedding in hot water with detergent.

##### *Chemical*

Treat pets with a veterinarian-approved insecticide. Then follow up with a continuous treatment, such as the flea pills or flea collars, as prescribed by the veterinarian. Also, treat rooms with residual or space insecticide or insect growth regulator (IGR) sprays.

#### *Control measures outdoors*

Outdoors you can use chemical and mechanical control measures.

##### *Chemical*

Flea control is difficult and probably should only be attempted if there is an actual or threatened plague outbreak. Treat rodent burrows with insecticidal dusts or set up dusting stations. If rodent control is part of the plague control program, kill the fleas first. Control operations should begin at locations where the cases of plague were acquired. Treatments should then be extended to adjoining areas as needed. When burrow surveillance shows that fleas are gone, then control the rodents.

##### *Mechanical*

Fence yards and other small areas to be protected to keep out domestic and wild animals that could shed fleas in the area.

## 235. Ticks

Ticks are found throughout the world, but they are less common in the arctic and subarctic zones.

### Tick groups

Ticks are divided into two groups: hard ticks and soft ticks (fig. 3-21).

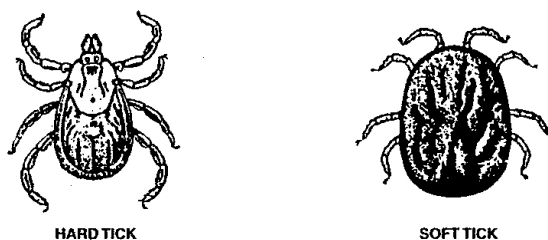


Figure 3-21. Hard tick and soft tick.

#### *Hard tick*

A hard tick has a hard shield on its back, and its mouthparts can be seen from above. The hard tick species includes lone star ticks, blacklegged ticks, American dog ticks, and Rocky Mountain wood ticks.

***Soft tick***

A soft tick does not have a hard shield on its back, and its mouthparts cannot be seen from above. A soft tick often has a leather-like appearance. A few species of soft ticks are known to spread relapsing fever and are, therefore, called “relapsing fever ticks.”

**Diseases spread by ticks**

Ticks spread four groups of deadly diseases to humans:

- Rickettsial diseases, such as spotted fever and Q fever.
- Bacterial diseases, such as tularemia.
- Spirochetal diseases, such as Lyme disease.
- Viral diseases, such as Colorado tick fever.

Hard ticks also can transmit other typhus-like fevers. Some species of hard ticks can even cause tick paralysis. This condition may result after a female hard tick has attached for several days to the base of a person’s neck or the back of the head on or near the hairline, making detection difficult. When tick bites are numerous, the skin may become badly inflamed and infected. Several species of soft ticks transmit relapsing fever.

***Rocky Mountain spotted fever***

Rodents are the natural reservoirs of Rocky Mountain spotted fever. The disease is transmitted to humans by an infected tick. There are two vector species that transmit this disease: the American dog tick and the Rocky Mountain wood tick.

This disease has a sudden onset with fever; chills; pain in the muscles, joints, and bones; and rashes. The disease lasts about two weeks, with mild symptoms the first week and more severe problems the second week. If the nervous system is affected, the patient could become agitated, act delirious, suffer insomnia, or lapse into a coma. Circulatory and pulmonary complications also could occur.

***Lyme disease***

Lyme disease occurs throughout much of the world and in CONUS appears concentrated in New England, with smaller concentrations in the upper midwest, the southeast, and the west coast. Lyme disease is a tick-borne disease caused by the spirochete *Borrelia burgdorferi*. It is also known as Erythema Chronicum Migrans (ECM) and tick-borne meningopolyneuritis in Europe. This is a chronic disease which affects several body systems if not treated and cured. Lyme disease begins with mild to severe flu-like symptoms, often with a characteristic “bullseye” skin lesion at the site of the tick bite. Initial symptoms are followed by a latent period where the individual is apparently disease free, but months to years later there will be involvement with joints and muscles (Lyme arthritis) and perhaps involvement with heart and nervous system.

Diagnosis is by laboratory tests and clinical findings. Treatment is by massive doses of antibiotics as soon after diagnosis as possible. Lyme disease may require long-term antibiotic treatment for cases diagnosed late in their course. Susceptibility is universal, and reinfection of people who have been cured has occurred.

There is no person-to-person transmission of Lyme disease. It is spread only by the bite of an infected deer tick or blacklegged tick (hard tick). The Lyme disease cycle is maintained in nature through transovarial transmission and by deer (which support large numbers of ticks), wild rodents (which support large numbers of rickettsia), and ticks.

**Transmission of disease**

Ticks are both mechanical and biological carriers of pathogenic organisms. Tick mouthparts, after feeding on infected animals, may become contaminated with pathogens that are inoculated into healthy animals when the tick moves from one animal to another. This mechanical transmission is called “infection through interrupted feeding.” Ticks also serve as reservoirs of viruses, rickettsiae, bacteria, and protozoa. Therefore, biological transmission of several rickettsial pathogens may occur from infected adults through the egg (transovarial transmission) to the subsequent larval, nymphal, and adult stages (transstadial transmission).

**IPM for ticks**

Again, you can use cultural, chemical, and mechanical control measures against ticks.

***Cultural***

Remove brush and ground litter from yards and recreational areas and keep grass mowed. Remove food sources for rodents, deer, and other animals that may serve as hosts for the ticks.

***Chemical***

Treat the infested area with a residual pesticide for use against ticks (acaricide).

***Mechanical***

It may require some time for ticks to infect a person after they attach to the body. Persons in tick-infested areas should examine themselves and each other at least every 2 hours to remove ticks. This process often prevents the transmission of disease.

If you do find an embedded tick on a human or animal, you must properly remove it to prevent transmission of disease and illness. To remove an embedded tick, take care not to crush it or leave mouthparts in the skin. Ticks are removed most effectively with small forceps—grasp as far forward on the mouthparts as possible and carefully pull them off with an upward even pressure. Ticks should not be grasped by the abdomens, since squeezing the abdomen will inject pathogens into the bite wound. Kill the removed tick with alcohol or heat. Treat the bite wound with an antiseptic.

**236. Mites**

Mites are found throughout the world in practically all climates. Although many mites feed on plants, some feed on humans and animals.

**Larval mites**

Mites lay eggs, which hatch into six-legged larval mites. Certain mites, such as chiggers, feed on humans and animals only in this larval stage. Larval mites develop into nymphs and then into adult mites. Both the nymphs and adults have eight legs.

**Species**

There are many species of mites. Some species of medical importance include itch mites, chiggers, house mouse mites, tropical rat mites, chicken mites, northern fowl mites, straw-itch mites, and grain and flour mites.

**Transmission of diseases**

Mites are pests that spread many diseases and cause numerous conditions that make them medically important. The transmission of organisms can be classified in three major groups of diseases:

1. Viral diseases, such as encephalitis (which is transmitted by certain bird mites).
2. Rickettsial diseases, such as rickettsialpox (which is transmitted by the house mouse mite) or scrub typhus (which is transmitted by chigger mites). Certain rodent mites also are involved in the transmission of rickettsialpox; this is a rare, nonfatal disease occurring primarily in large cities in the United States and Russia.
3. Bacterial diseases, such as tularemia (which is transmitted by the rat mite only in a laboratory) and epidemic hemorrhagic septicemia (which is transmitted by the snake mite).

**Conditions caused by mites**

Some of the diseases spread by mites include scabies or mange, dermatitis, body infestations, and scrub typhus.

***Scabies or mange***

Scabies or mange-like conditions are produced primarily by mange, itch, or follicle mites. These mites burrow and live in the skin of man, and cause a condition called “scabies” (or the “seven year itch”). This condition is not fatal, but may cause discomfort due to intense itching, especially at night. Scabies is often found among people who do not or cannot practice good personal hygiene. Additionally, hospital personnel may become infested after caring for infested patients. Scabies mites are transferred from person to person by personal contact or by using or wearing infested clothes, bedding, or towels.

***Dermatitis***

Dermatitis is produced primarily by direct attack from chiggers, bird and rat mites, straw-itch mites, and cheese and flour mites. Bites from chigger mites and some rodent mites also may cause severe itching, and infection could result from scratching these areas. In Southeast Asia, some chiggers transmit a dangerous disease called “scrub typhus” or “Tsutsugamushi disease.” Chiggers often live in tall grass or scrub vegetation, and appear when land has been cleared and abandoned. People entering these mite infested areas may be attacked by chiggers.

***Allergic reactions***

Allergic reactions can occur from exposure to either entire mites or particles of mites, as well as their excreta. These conditions may be similar to asthma.

**IPM for mites**

Cultural, chemical, and mechanical control measures are impractical or ineffective against mites. Repellents and other personal protective measures are the only realistic means of protection. Washing with hot, soapy water will remove any mites that are still feeding; and washing and applying an antiseptic itch relief medication may help relieve symptoms.

**237. Cockroaches**

Cockroaches are generally flattened, running insects that are nocturnal; cockroaches seek warm, dark, secluded areas. They develop from egg to adult through gradual metamorphosis, with the number of instar (developmental) stages ranging from 6 to 13. Some species live for 3 months, while others live more than a year; some have been reported to live longer than 3 years.

### Species of cockroaches

There are over 3,000 species of cockroaches in the world, but only a few are actually a problem for people in domestic situations (fig. 3-22).

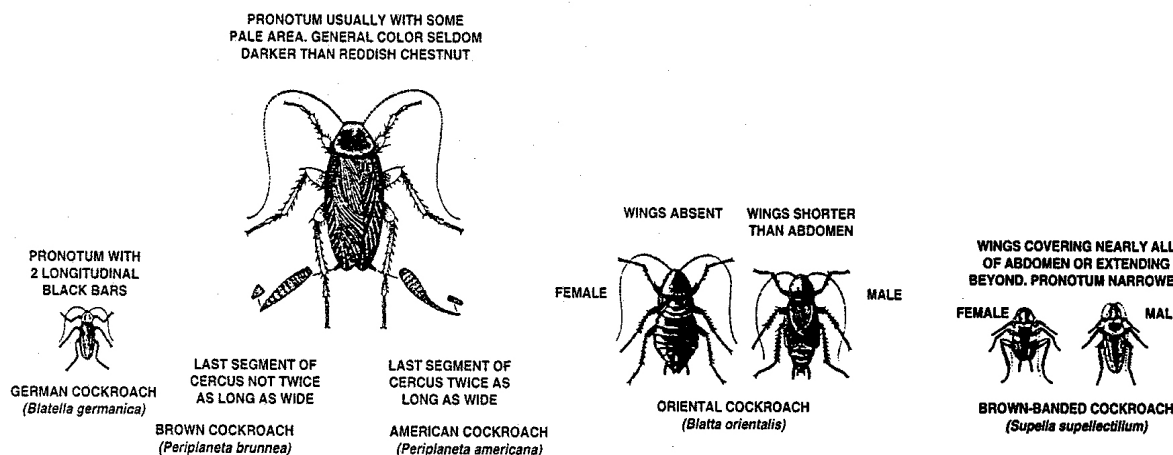


Figure 3-22. Various species of cockroaches.

#### German cockroach

The German cockroaches are the most abundant cockroach species in the United States. They are found in homes, apartments, restaurants, and hospitals where warmth, moisture, and food are readily available. They are found under stoves, ranges, refrigerators, in the insulation of appliances, under sinks, in dead spaces behind the sink, around water heaters, in and around cabinets or pantries, behind baseboards and moldings, and in other dark protected areas. They average 12 to 16 millimeters in length, and they are pale yellowish brown or tan in color. Like most cockroaches, the German cockroaches are nocturnal, and search for food and water at night.

#### American cockroach

The American cockroach is the second most abundant species of cockroach in the United States. They are found mostly in commercial establishments, such as restaurants, hotels, packing houses, bakeries, hospitals, prisons, office buildings, and grocery stores. These cockroaches are about 30 to 40 millimeters in length, and they are chestnut (reddish) brown in color. They are not found very often in houses or apartments. The American cockroaches can be found in sewer systems where they can enter into an establishment looking for food.

#### Oriental cockroach

The Oriental cockroaches are much larger and darker in color than the German cockroaches. They are dark brown to black in color and about 22 to 27 millimeters in length. They are found in cooler climates, and can adapt better to the outdoors, even in extreme weather conditions, than other species. The Oriental cockroaches reproduces at a slower rate than the other species, which keeps the populations at a somewhat lower level. These cockroaches typically are found in damp basements and crawl spaces of buildings. When infestations are heavy, a typical roach odor is more noticeable in these cockroaches than the other species.

***Brownbanded cockroach***

The brownbanded cockroach is far less important than the German cockroach in the United States. This insect is usually found in cupboards, pantries, TV cabinets, picture moldings, and shelves in closets. The color of the brownbanded cockroach is similar to the German cockroach, except for two light brown cross bands. The size of the male averages 13 to 14 millimeters, while the female averages 11 to 12 millimeters. Often, the difference in size of the sexes causes people to think there are two species of cockroaches infesting an area.

**Transmission of diseases**

Cockroaches are not known to directly transmit disease. However, they do travel through filth, picking up pathogenic organisms on their bodies and mechanically transferring these organisms to unprotected food. For this reason, infestations are considered a potential health hazard.

**IPM for cockroaches**

The most effective method of controlling cockroaches is through denying them access to food or moisture; however, once there is an infestation, the use of pesticides is usually indicated. Again, insecticides will not work well if housekeeping is not maintained. Clutter such as piles of magazines, newspapers, boxes, and paper bags are breeding areas for cockroaches and should be removed to prevent harborage. Also, cluttered areas protect the cockroaches from insecticide applications.

***Cultural control***

Area sanitation is the single most important aspect of cockroach control. Remove food, water, and harborage; and the cockroaches will go away.

***Chemical control***

Normally chemical control is used with cultural control, but is often used too frequently – chemical treatment should be based on surveillance and not on an inflexible schedule. Usually you would apply residuals in places where the cockroaches will contact them; and you must be careful to use “crack and crevice” treatment in food preparation and consumption areas.

Insecticides should not act as a repellent to roaches, rather they should go unnoticed until they effectively control the exposed insect. One example of this type of insecticide is boric acid, which attaches to the body; it is ingested by the insect and acts as a stomach poison to kill the cockroach.

Cockroaches have developed resistance to some chemical insecticides; therefore, it is important to work with your CE pest management personnel to rid an establishment of cockroaches.

***Mechanical control***

Seal entrances, such as cracks in walls and windows, wall voids, and holes around water pipes.

**238. Venomous arthropods and snakes**

Air Force personnel stationed in the United States face a greater risk of contacting a venomous arthropod than the average U.S. resident because (1) many bases are located in the southern half of the United States where venomous arthropods are most numerous; (2) facilities such as radar, communications, security, and missile sites are located in remote areas where venomous arthropods are not controlled; (3) numerous Air Force training and work activities are performed outside; and (4) many military structures, such as older wooden buildings, storage buildings, and field training facilities, provide excellent habitats for venomous arthropods. It is important, therefore, that your medical facility has current information on the most important venomous arthropods in your area.

**Species of venomous arthropods**

Venomous arthropods include bees, wasps, hornets, spiders (such as black widow and brown recluse), scorpions, centipedes, and certain caterpillars.

**Species of venomous snakes**

There are about 136 species of snakes in this country; 21 of these species are venomous. Furthermore, at least one venomous species of snake is found in every state in the United States, except Alaska and Hawaii.

**Medical importance**

Most people know about the pain and discomfort associated with contacting a venomous arthropod. However, many are not aware that ants, bees, wasps, spiders, and scorpions cause more human deaths in the United States each year than any other group of venomous animals, including snakes. Additionally, some venomous arthropods are directly involved in disease transmission, such as the kissing bug which is the vector of Chagas disease.

**Arthropod venom**

Venomous arthropods sting (like a bee or wasp), bite (like a spider or centipede), or produce fluids (like vesicating blister beetles) to transmit their venom to victims.

Arthropods produce five basic types of venom:

1. Hemolytic toxin, which breaks down the red blood cells. It also may kill large blocks of tissue in the area of envenomization.
2. Neurotoxin, which is a systemic toxin that affects the central nervous system. It inhibits reflexes and may cause shock in severe cases.
3. Urticating toxin, which produces wheals or raised areas on the skin. These areas may itch or be intensely painful.
4. Vesicating toxin, which produces blisters on the skin.
5. Hemorrhagic toxin, which prevents normal blood clotting and causes a reddening of the skin in the envenomized area.

Venomous arthropods can sting (like a bee or wasp), bite (like a spider or centipede), or produce fluids (like vesicating blister beetles) that can cause pain and swelling as well as other severe medical problems.

**Control measures**

Control measures for these different varieties of arthropods vary depending upon the species. However, there is one effective control measure that works well for almost all venomous arthropods—avoidance! If you know venomous arthropods are around, stay away or use insecticides.

### Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

#### 232. Lice

1. What are the common names for the three distinct varieties of lice that infect humans?
2. What is the most important louse-borne disease?
3. How are pathogens for epidemic typhus and trench fever spread from lice to humans?
4. How are the spirochetes of relapsing fever spread from lice to humans?
5. What is the *most effective* method of prevention for all lice?

#### 233. Flies

1. What is the *most* common type of fly?
2. What are the two major categories of flies?
3. To which of the two major groups of flies does a sand fly belong?
4. What are the five ways flies spread diseases?
5. What is the *most* effective fly control measure?

**234. Fleas**

1. In what insect order are fleas classified?
2. What diseases are fleas responsible for transmitting?
3. How is endemic typhus (murine typhus) transmitted to humans?

**235. Ticks**

1. What are the two major groups of ticks?
2. To which of the two major groups does the American dog tick belong?
3. What are the four major groups of diseases that are spread by ticks?
4. What is meant by “transovarial transmission” of pathogens?
5. What is the most effective method for removing a tick?

**236. Mites**

1. What stage are chiggers in when they feed on humans and animals?
2. What are the three major groups of diseases transmitted by mites?
3. Which mites burrow and live in human skin?

4. What species of mite transmits scrub typhus?
5. What forms of control are impractical for mites?

**237. Cockroaches**

1. What is the most abundant species of cockroach in the United States?
2. What color are German cockroaches?
3. Where are American cockroaches mostly found?
4. Why are Oriental cockroach populations at a somewhat lower level?
5. What is the *most* effective method of control for cockroaches?

**238. Venomous arthropods and snakes**

1. About how many *venomous* snakes are there in the United States?
2. What is the vector of Chagas disease?
3. What are the five basic types of venom that arthropods and snakes produce?
4. Venomous arthropods do what three things that cause pain and swelling?

5. What type of venom produces blisters on the skin?
6. What is the one control method that is effective against *all* venomous arthropods?

### **3-4. Rodents**

A rodent is an animal of the order Rodentia, such as a mouse, rat, squirrel, or beaver, that is characterized by large incisor teeth that are adapted for gnawing or nibbling. Rodents are grouped as either domestic or wild. These two groups are further divided into species.

#### **239. Types of rodents and methods of control**

Domestic rodents are nocturnal. Ordinarily, they do not move about during the day, since they prefer the cover of darkness to forage for food and water. They move in narrow runs along buildings, walls, pipes, and overhead beams. Rodents gnaw through materials to obtain food and harborage. Wood is not a barrier to rodents, since they have very sharp teeth that quickly cut through it. These pests damage far more food than they eat. For example, they commonly take one bite out of many potatoes instead of eating one entire potato. They sample many bags of flour, eat many pieces of meat, and contaminate food items with urine and feces.

##### **Mice**

The most common mouse species is the house mouse (fig. 3-23). The house mouse is the smallest of the domestic rodents and is widespread throughout the United States. It is found from the tropics to the Arctic Ocean regions of the world. It is dusky gray in color and it has smaller feet and a smaller head than a young rat. Its droppings (feces) are small and rod shaped.

##### **Rats**

The most common rat species include the Norway rat and the roof rat. See figure 3-23 to identify some of the differences between these rats.

##### ***Norway rat***

The Norway rats, predominantly burrowing rodents, are the most common and largest of the domestic rats. Their fur is coarse and its color is reddish brown, with black to light gray or tan. Their droppings are large (up to three-fourths of an inch long) and capsule-shaped. Norway rats live one to seven years and burrow in the ground, under building foundations, and in rubbish dumps. They normally travel up to 100 feet from their dens.

##### ***Roof rat***

The roof rats are agile climbers. They are medium sized rodents found from the southern United States to the Pacific Coast; however, they are found most abundantly in the tropical or temperate regions of the world. They exhibit three different color patterns, which indicate the subspecies. The black rat is black to slate gray; the Alexandrine rat is tawny above with a grayish white belly; and the fruit rat is tawny above with a white to lemon-colored belly.

The roof rat's droppings are medium sized and spindle shaped. Roof rats live one to seven years, nest indoors in attics and between walls, and outdoors in trees and dense vine growth. Their travel distance is about the same as the Norway rat.

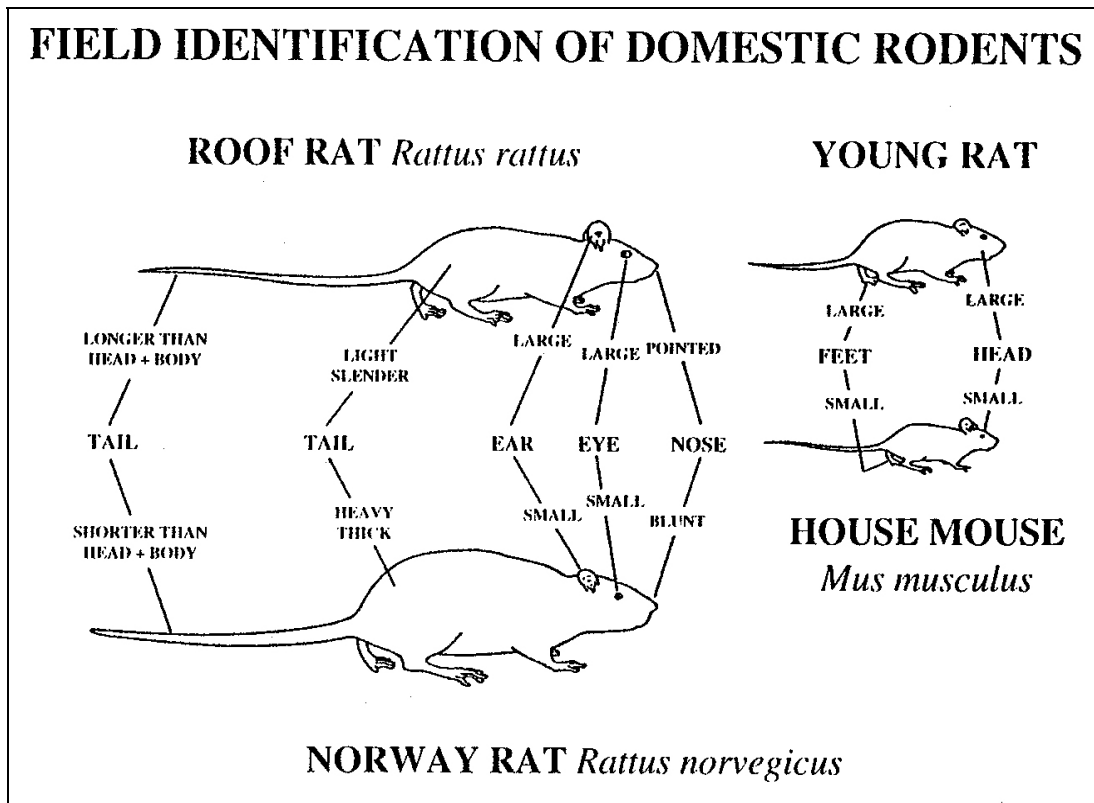


Figure 3-23. Types of domestic rodents.

### Wild rodents

Wild rodents are also a nuisance, and they can spread disease to other animals and to human populations. Wild mice include the white-footed mouse, meadow mouse, and the pine mouse; wild rats include wood rats and cotton rats. These rodents rarely spread disease agents to humans, but sometimes they do infest food supplies. Other wild rodents include ground squirrels, prairie dogs, and gophers.

### IPM for rodents

The best method for controlling rodents is prevention through environmental sanitation and physical preventive measures. Prevention of entry into buildings, frequent and thorough cleanup of trash and debris, proper waste disposal, proper food storage, and elimination of food sources and harborage are all preventive measures in rodent control.

### Cultural

Rat-proofing is a fundamental physical control method to prevent rodent infestations in buildings. Rat-proofing should be included in the plans for all new construction. On existing structures, this consists of changing building structural details to prevent rodent entry. Openings as small as one-half inch admit mice and young rats. Rat-proofing includes sealing holes, replacing screens and doors to ensure tight closures, and replacing rotten wood or other material that rodents can get through to enter the building.

### ***Mechanical***

Mechanical control is achieved with traps that can be used in any area where food is handled or prepared. A large number of traps should be used, since a 10-percent catch is considered good. Various types of mechanical traps are available; the type used most frequently is the snap trap that kills the rodent.

### ***Chemical***

On USAF installations, pesticides should be placed only by trained, certified CE pest management personnel. Chemical control can be achieved with rodenticide bait stations. These bait stations are safe even in the kitchen if properly placed by CE pest management personnel.

Because of the high toxicity of acute single-dose poisons, anticoagulants or other chronic rodenticides also are generally recommended. Some anticoagulant poisons, such as warfarin, pival, and fumarin, kill in a radically different manner from the acute single-dose poisons. Ingestion of anticoagulants must occur for several days before they are effective. This fact provides a definite safety factor for areas where there are children or other animals that could eat a single portion of anticoagulant bait.

## **240. Diseases attributed to rodents**

Although there many diseases that can be attributed to rodent infestation, only a few of the more important ones are presented in this lesson. The diseases you will learn about in this lesson include various kinds of plague, endemic typhus, leptospirosis, scrub typhus, tularemia, salmonellosis, trichinosis, and rat-bite fever. You will also learn something about measures that can be used to prevent and/or control rodent infestation, thus reducing the incidence of these diseases.

### ***Plague***

Plague is a worldwide pathogen of rodents. Although it is primarily a disease of rodents, humans are sometimes infected. Typically, the plague pathogen is transmitted through the bite of a flea that previously fed on an infected rodent. However, fleas are capable of transmitting the disease from human to human and pet to human. As plague also can be transmitted in respiratory droplets, it is sometimes transmitted through airborne droplets resulting from coughs.

### ***Symptoms***

There are three types of plague that affect humans:

- Bubonic, which affects the lymph nodes.
- Septicemic, which affects the blood stream.
- Pneumonic, which involves the lungs.

Plague is an acute, rapidly progressing disease. All three forms of the plague begin with similar symptoms, such as fever, malaise, headache, sore throat, shock, restlessness, mental confusion, and prostration. If the disease progresses without treatment, there is about a 50-percent chance of death from bubonic plague and about 90- to 95-percent chance of death from other forms of the plague. However, the percentages drop if the disease is detected and treated quickly.

### ***Surveillance program***

The Air Force established the Plague Surveillance and Prevention Program in 1977, and program guidelines are updated periodically. Published guidelines are available through your MAJCOM PHO or AFIERA at Brooks AFB.

Bases in the United States near to or west of the 100th meridian conduct this program which includes five main elements: (1) coordination of program activities with AFIERA at Brooks AFB, Texas, and public health agencies; (2) education of the local population on the recognition and prevention of plague; (3) surveillance of rodent populations to determine any changes in size; (4) control of rodents, wild animals, and domestic animal fleas; and (5) diagnosis/treatment of plague patients.

### **Leptospirosis**

Infections result from either direct or indirect contact with the urine of infected rodents or other animals. The spirochetes, which cause leptospirosis, can contaminate water or food; or they may enter the body through mucous membranes, minute cuts, or skin abrasions.

Leptospirosis symptoms vary from case to case. Classical case symptoms begin suddenly and include fever, headache, myalgias, conjunctivitis, nausea, vomiting, diarrhea, and constipation. Prostration or exhaustion may be severe. However, most cases either are asymptomatic or produce mild flu-like symptoms.

### **Hantavirus**

Hantavirus is an acute viral disease that is characterized by fever, muscle pain, and gastrointestinal complaints, followed by the abrupt onset of respiratory distress and hypotension. The illness progresses rapidly to severe respiratory failure and cardiogenic shock. The crude mortality rate is approximately 40 to 50 percent. In survivors, recovery is rapid, with apparent full restoration of normal lung function.

Several hantaviruses have been identified in the Americas, including:

- Sin Nombre virus.
- Black Creek Canal virus.

Sin Nombre virus is the agent responsible for the 1993 epidemic in southwest United States and for most of the other cases of hantavirus identified in North America. The major reservoir of Sin Nombre virus appears to be the deer mouse, *Peromyscus maniculatus*. Aerosol inhalation transmission from rodent excreta and saliva is presumed, however. There is no evidence of human to human spread. Incubation is approximately 2 weeks, with the possibility of a range from a few days to 6 weeks.

Hantavirus pulmonary syndrome was first recognized in the spring and summer of 1993 in the Four Corners area of New Mexico and Arizona among resident Native American populations. Since then, cases have been confirmed in 20 predominantly western states and Canada. Also, sporadic cases have occurred in eastern regions of the United States, including Florida, Rhode Island, New York, and Indiana. This disease is not restricted to any ethnic group. A seasonal pattern coinciding with the presence and increased number of the carrier rodents appears to be present.

## **241. The nature of rodent surveillance**

In your job you need to be aware of surveillance methods, such as sight, sound, droppings, runways and rub marks, tracks, and gnawings. You also need to know how to collect, pack, and ship specimens. In this lesson, you will learn something about each of these topics.

### **Surveillance methods**

You may be required to work with CE pest management personnel to identify a rodent infestation. To decide what type of rodent is involved and the size of the problem, you need to know what to look for. Let's take a look at how you would investigate a rodent infestation.

### ***Sight***

The most positive proof of an infestation, of course, is the sighting of a live rat or mouse. Since they are nocturnal and secretive in their habits, you seldom see them alive. As a rule, it is only in very heavy infestations that they show themselves around humans. These creatures are especially secretive if there is much human activity in the area.

Dead animals indicate either a current or past infestation. If the carcass is dried or reduced to a skeleton, it may mean only a former infestation. If there are many recently dead rodents, find out if poisons were used in the area. If no poisons were used, there could be a zoonotic disease, such as plague, among the rodents. Never handle dead rodents with your bare hands! If possible, place them in cloth, paper, or plastic bags to prevent the escape of fleas and other ectoparasites.

### ***Sound***

Various rat and mice noises may give clues as to their presence and location. These noises are rarely heard unless the area is quiet. When you enter a building you suspect is infested, stand still and listen for rodent activity. You may hear sounds of running, gnawing, and scratching, especially from double walls and floors. Rodents also produce various squeaks and noises. The squeaking may accompany fighting and occur intermittently for several minutes, or it may be youngsters in the nest.

### ***Droppings***

Presence of rat and mouse feces is one of the best indicators of an infestation. All animals commonly produce quantities of droppings. The droppings may be a key to the species and abundance. It is important to tell the age of the rat and mouse droppings so you can decide whether the area is currently infested. Fresh droppings are soft enough to be pressed out of shape and often have a glistening, moist appearance. Although the color varies according to the kind of food eaten, it is usually black. Within a few days, depending on climatic conditions, droppings become dry and hard. The surface becomes dull later, and with great age, it assumes a grayish, dusty appearance and may crumble easily when pressed with a stick.

The surface appearance alone may be misleading. Droppings may be black and shiny and still be hard and crumbly. Old droppings dampened by rain or moisture may look fresh, but when crushed, they do not have the putty-like consistency of fresh droppings.

### ***Quality and size***

The quality and sizes of fresh droppings may suggest how many animals are in an area. Fresh droppings mean there is at least one rat or mouse. Since only rarely are Norway and roof rats found in the same area, presence of several sizes of fresh droppings means there are several ages of rats which are probably reproducing. This is often the case in extensive infestations. Droppings are most numerous along runways, near harborage, in secluded corners, and near food supplies. In contrast, the burrows and nests are usually very clean without droppings. Rats and mice have been seen carrying feces from nests and burrows!

### ***Quantity***

The number of rodent droppings in any area depends not only on the amount of rodent activity but also on how often floors are swept and how rapidly stored goods are moved. The absence of droppings does not always mean there are not any rodents. Droppings are irregular; sometimes they are abundant, sometimes scarce. On the other hand, the presence of old droppings, even in quantity, does not mean that the area is currently infested.

***Pathways***

Since rats and mice generally occupy only a limited area, they may use the same pathway many times. These pathways are about 2 to 3 inches wide. Outdoors the earth looks cleanswept and packed. Indoors, rats and mice leave dark smears or rub marks on large objects, such as walls and rafters, from their natural body oils and dirt.

***Rub marks***

Rub marks are found most often along walls, under boards, behind stored objects and accumulated litter, and in similar places. It is important to search such places carefully.

You can find the rub marks around gnawed holes, along pipes and beams, on the edges of stairs, along walls, or anywhere else that the rodent travels. Swing marks, which are made by rats that pass along a beam under floor joists, generally indicate the presence of roof rats. Norway rat runs are found more often near the floor. House mouse runs can be found anywhere, but they are the most difficult to locate because they are small and often very faint. It is especially important to search behind vertical pipes and columns, since they are the favorite means for rats and mice to change floors.

You often can tell how old a rat or mouse run is. Fresh rub marks and smears are soft when you scratch them; old ones are brittle and may flake off. By tracing rat and mouse runs, you can find the harborage, food and water supply, and means of entry into buildings. This information will help you take the right control measures.

***Tracks***

Tracks are the floor foot prints found along indoor and outdoor rat and mouse runs. You can see tracks more clearly with side illumination from a flashlight than from above direct light. It is helpful to use a fine dust for tracking. Dust a fine powder, such as flour, on a suspected runway and inspect it later for footprints. Spread the powder smoothly to a depth of no more than 1/8th inch. Then when you inspect, look for prints of the five-toed hind feet and the four-toed front feet.

***Gnawed wood***

Recent gnawings through wood can be distinguished by the fresh, light-colored appearance of the gnawed surface and the presence of small, chewed pieces or cuttings in the vicinity. The edges of the gnawed area darken in a few days, and small cuttings are soon scattered or swept away. Another way to determine the age of gnawed openings is to notice the sharpness of the bitten edges. A freshly gnawed opening has sharp edges that scratch the animals as they pass through. They will stop and nibble at the offending edge so that as the openings become older, they acquire well-rounded edges. Evidence of recent gnawing is one of the most reliable signs for determining the presence of rats and mice.

***Collecting specimens***

There are many ways to collect rodents. The easiest way to collect them is to trap them. There are a few different types of traps, including steel traps, wire live traps, and multiple catch box traps. Different baits should be used to ensure the rodents are attracted. These traps should be placed in or on their runways or pathways.

Another type of trap is a glueboard. The glueboard may be tacked down to the floor to prevent the rodent from dragging the board around. This type of trap can be used where rodenticides are not recommended, such as around children and food service areas. The glueboard catches the rodent and the rodent remains alive for several hours. If only one leg is caught, a rat might chew off that leg to escape.

Consult CE pest management personnel if you identify problems with trapping rodents. Your base pest management personnel will probably do the trapping for you if you ask them to. If necessary you can consult with AFIERA personnel at Brooks AFB, Texas, for further information on trapping rodents.

### **Packing and shipping specimens**

To collect ectoparasites for shipment for identification, you must check rodent traps each morning, because the ectoparasites will not remain on dead rodents. If you wish to ship only the rodent ectoparasites, kill the rodent and comb the rodent to remove the ectoparasites or pick sticktight fleas or ticks off with forceps.

#### ***Packing***

The most important requisite for preparation and shipment is that your ectoparasite specimens arrive at the laboratory in a condition that will permit proper identification; that is, you must ensure the identification characteristics are as complete and undamaged as possible. Prepare the ectoparasites for shipment by placing them in a 5-ml blood-collection vial containing 70-percent alcohol. As you push the rubber stopper into the neck of the tube, a bubble of air is usually trapped. Since this bubble will damage specimens as it passes over them during shipment, it must be removed. Insert a hypodermic needle into the stopper to allow the trapped air to escape.

Be very careful to prevent breakage of specimen slides or bottles containing preservatives when you prepare specimens for shipment. In the tropics, be careful to store insects in alcohol. This will prevent mold. You can quick-freeze or use dry ice to lengthen the time specimens can be in transit.

#### ***Shipping***

Do not ship specimens without first contacting the laboratory and making prior arrangements for the shipment. Properly tag or label all specimens for shipment. Include all information on locality, date, and elevation at which the collection was made. Also include the collector's name and other pertinent information such as habitat, abundance, and distribution of the specimens. If there are any questions concerning shipment of any specimens for identification, contact the Environmental Biology Branch, AFIERA, (DSN 240-6135), and Brooks AFB, TEXAS 78235.

### Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

#### 239. Types of rodents and methods of control

1. What is the *most* common species of mouse?
2. What do the droppings (feces) of a house mouse look like?
3. What is the largest and *most* common domestic rat?
4. What are the three color patterns found in roof rats?
5. What are the two *best* control methods for rodents?

#### 240. Diseases attributed to rodents

1. What is the *most* important rodent-borne disease?
2. What are the three types of plague that affect humans?
3. Which of the three types of plague affects the lymph nodes?
4. When did the Air Force establish the Plague Surveillance Prevention Program?
5. How does one acquire leptospirosis?

6. What are the symptoms with *most* cases of leptospirosis?
7. What is the crude mortality rate of hantavirus?
8. Where in CONUS have most cases of hantavirus occurred?

**241. The nature of rodent surveillance**

1. Besides sighting a rodent, what is one of the *best* indicators of a rodent infestation?
2. What happens to aged rodent feces?
3. How wide are rat and mouse pathways?
4. Where are most rodent rub marks found?
5. How can you determine if a rodent run is new or old?
6. To identify tracks, how deep do you spread powder (or flour) on a rodent run?
7. What type of trap is recommended for trapping rodents around children and in food service facilities?
8. How do you pack ectoparasites for shipment to a laboratory?

### **3-5. Control Programs**

It is important for you to know about the different control programs for pest management in the Air Force, since you may need to recommend ways to control pests in facilities on base. In this section you will learn about the AF Pest Management Program and the Air Force Quarantine Programs so that you will know who is responsible for the various aspects of pest control.

#### **242. Air Force Pest Management Program**

Pests include any organisms that are in the wrong place. Pests can be arthropods, weeds, rodents, birds, wild animals, snakes, nematode worms, snails, etc. Many of these have no medical significance; however, the core mission of PM is to prevent or eliminate pests. This mission is accomplished in a variety of ways, preferably without involving chemical pesticides.

##### **Responsibilities**

The overall entomology program within the Air Force is conducted by the base civil engineer pest management (PM) function, with assistance from the base PH and a few other players. In general, PM surveys for all pests, except disease vectors and medical pests, and controls all pests, particularly if pesticidal control is needed. The PM function is usually found within the operations and maintenance area (abbreviated CEO) of the base civil engineer unit. It is usually a mix of military and civilian personnel. Contractors may augment, or in some cases provide all, pest management services. During contingencies, military PM technicians deploy, and their home station jobs are accomplished by the civilian and contractor components of the PM shop.

PH surveys for disease vectors and medical pests, cooperates with PM in the nonpesticidal aspects of pest management, and interfaces in several areas.

Four major directives define the Air Force Pest Management Program:

- DOD Directive 4150.7, The DOD Pest Management Program.
- AFI 32-1053, The Pest Management Program.
- AFI 32-1074, Aerial Dispersal of Pesticides.
- AFI 48-102, The Medical Entomology Program.

AFI 32-1053 defines pest management as follows:

“The effective, economical, and environmentally sound prevention or control of animal pests and vectors, undesirable terrestrial and aquatic plants, and plant diseases. It includes such methods as: education; inspection (surveys); sanitation and proper waste management (such as use of pressure washing and self-closing compactors); proper storage of food and other pest-susceptible items; exclusion, trapping, and other mechanical or physical means of containing pests (such as using portable vacuum cleaners); pest-preventive building construction and maintenance (caulking); biological control; minimal use of pesticidal chemicals in a manner (such as containerized baits and crack and crevice applications) that causes the least harm to the environment.”

##### **Air Force policy**

Because of the temporary nature of chemical control, and its potential threat to human health and the living environment, Air Force policy is that integrated pest management (IPM) will be used to the maximum extent possible to control all pests. AFI 32-1058 defines IPM as, “a planned program, incorporating continuous monitoring, education, record keeping, and communication, to prevent pests and disease vectors from causing unacceptable damage to operations, people, property, materiel, or the environment.”

IPM uses targets, sustainable (effective, economical, environmentally sound) methods including education, habitat modification, biological control, genetic control, cultural control, mechanical control, physical control, regulatory control, and where necessary, the judicious application of least-hazardous pesticides. The most common techniques used in IPM include cultural control, mechanical control, biological control, and chemical control.

### ***Cultural control***

Cultural control consists of changing the environment so that the pests to be controlled can no longer live there. Cultural controls are generally long-term or permanent, avoid pesticide contamination and insecticide resistance, and are often inexpensive and simple, such as cleaning kitchens to suppress cockroaches. The disadvantages to cultural control include feasibility (draining and filling a wetland for mosquito control), and financial considerations.

### ***Mechanical control***

Mechanical control consists of using physical or mechanical methods (e.g., fly swatter or window screens) to kill or separate arthropods from their food source. The advantages of mechanical control are low costs and low chemical threats to the environment. However, mechanical controls are sometimes expensive, time consuming, and/or impractical.

### ***Biological control***

Biological control consists of using predators, pathogens, or genetic engineering to control arthropods. A good example of biological control is the use of minnows to control mosquito larvae. Advantages of biological control include the fact that there are no chemicals and there is little to no damage to nontarget organisms (e.g., dragonflies and amphibians). Disadvantages include high costs, frequent reapplication of the control agent, and low efficacy. For example, genetic engineering requires specially trained people, sophisticated rearing and storage areas, and delivery systems.

### ***Chemical control***

Chemical control is the use of pesticides to kill or break the life cycles of pests. Pesticides are typically immediate and inexpensive in the short term. However, many are hazardous to human health, nontarget organisms, and the environment if not used properly. Chemical control is not permanent, and reapplication is usually necessary, sometimes at frequent intervals. Over time, chemical control may result in chemical resistance.

Pesticides are chemicals that are deliberately applied to kill pests, and they can be classified by the type of pest that they kill:

- Insecticides kill insects.
- Rodenticides kill rodents.
- Herbicides kill weeds.
- Acaricides kill ticks and mites (acarines).
- Molluscicides kill mollusks (snails and slugs).

Insecticides can also be classified by the stage of the insect life cycle they attack (adulticides, larvicides, or ovicides), the way they are applied (space, residual, or fumigation), their chemical structure (organophosphates, carbamates, pyrethroids, or organochlorines), and their origin.

### Governing laws

Pesticides are governed by federal laws, with the major governing legislation in the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) of 1942. In 1972, Public Law 92-516 passed the Federal Environmental Pesticide Control Act (FEPCA), which resulted in restrictions on pesticide use and added requirements for applicator training. Some major provisions of the law are as follows:

- Pesticides must be used according to the label directions only. The “label” in this provision refers to the paper directions for use that are attached on (or with) the original pesticide container.
- Pesticides are classified as “General Use” or “Restricted Use.” Restricted Use classification is given to a pesticide when the EPA determines through testing that it may cause adverse effects on the environment. If the EPA determines that the pesticide poses no such problems to the environment when it’s applied according to the label, it is considered to have a General Use classification.
- The use of Restricted Use pesticides requires a certified and competent applicator, or someone who is under the direct supervision of a certified applicator.
- The EPA has established severe penalties for violations of pesticide misapplication.

### Pesticide labels

The pesticide label contains the most important information concerning the product. The label contains information which classifies the pesticide as a restricted use or general use pesticide. The label also contains the Hazard warnings to the user and the statement, “Keep out of reach of children.” Other label parts found include, trade name, common name, ingredient statement, net contents, name and address of manufacturer, registration and establishment number, directions for use, misuse statement, reentry statement, storage and disposal directions, Type of formulation, precautionary statement, environmental hazards, physical and chemical hazards, and statement of practical treatment.

Insecticides, the most common pesticides, are designed to kill insects, but are usually toxic to other arthropods, such as mites, ticks, and spiders. Insecticides are grouped as follows:

- ***Inorganic insecticides.***  
Made from naturally occurring minerals. Developed during the 1940s, and one of the first types of insecticide to be used in a large-scale control programs. They are no longer stocked or used by the military, except for boric acid.
- ***Organochlorines.***  
Primarily affect the central nervous system. They are used against a wide range of insects. Due to their long-term persistent problems in the environment, they have decreased in use within the CONUS. Examples are DDT, Chlordane, and Lindane.
- ***Organophosphates.***  
This type of insecticide has replaced the chlorinated hydrocarbons for pest control. They kill by inhibiting the cholinesterase enzyme that affects nerve function. Examples are malathion, chlorpyrifos (dursban), and diazinon.
- ***Carbamates.***  
The carbamates also inhibit the enzyme cholinesterase. An example is carbaryl (Sevin®)

- ***Pyrethroids.***  
Synthetic pesticides that act on the central nervous system of the insect. Pyrethroids tend to have low mammalian toxicity and are widely replacing the other types of insecticides. Examples are permethrin, cypermethrin, d-phenothrin, and allethrin.
- ***Growth regulators.***  
Cause the pest to develop improperly which inhibits reproduction. This type of insecticide is generally nontoxic and affects only the target pest. These products are widely used in the pest control field. Examples are Gencor and Precor.

### **Other IPM considerations**

Base control measures on surveillance—find out if the pest is there, and if so, where, when, and why. Do not control pests that are not there, and do not use control methods that are ineffective. This is particularly important for chemical control methods. Study the pest, its life cycle, and its environment carefully, then use as many types of control in the IPM program as practical. Place minimum emphasis on chemical control and maximum emphasis on the other control techniques.

### **243. Air Force quarantine programs**

The Air Force has developed two programs geared to protecting our country from pests. These programs are the retrograde materiel preclearance program and the Military International Quarantine (MIQ) Program. Although the military is not the only organization performing these duties, the Air Force does play a very important role in the prevention of transporting unwanted pests, plants, animals, and diseases since the Air Force travels daily all over the world.

**NOTE:** Although the disease quarantine program is not a medical entomology program, it fits logically with the inspection of aircraft under the Military Quarantine Inspection Program. Therefore, it is covered in this section.

#### **Retrograde materiel preclearance program**

The retrograde materiel preclearance program objective is to ensure that aircraft and cargo are inspected, disinfected, and certified pest-free before takeoff. Of course, this only includes aircraft that depart overseas areas for return to the United States or to another country. Even though the guidelines do not specifically cover aircraft leaving the United States to go to another country, you should include this in your program, if you are at a point of debarkation (a port where planes leave to go overseas).

#### ***Responsibilities***

The medical treatment facility (MTF) commander is responsible for providing technical guidance as well as qualified inspectors to ensure aircraft are free of pests and diseases. Within the medical arena, PH is frequently responsible for providing both the technical guidance as well as the inspectors to check the aircraft. The installation commanders have the overall responsibility for ensuring nothing harmful is transferred to another area. The commanders usually rely on the medical community for assistance with this responsibility; however, there might be instances in which PH inspectors may not be allowed to check an aircraft because of top secret operations. Do not argue with your installation commander's decision to deny you access; just document that you tried to do your job and go about your other duties.

#### ***Aircraft evaluation***

You might be surprised at what “cargo” can travel along with the aircraft. If you have never seen a large aircraft up close, you may be surprised to learn that it is easy for a snail or some insect to “hitch” a ride to another country. There are many places outside and inside the aircraft where insects, pests, animals, and plants can hide from your inspection. Also, there is a likelihood that pests, insects, animals, and plants are in the cargo area in suitcases, boxes, and other containers.

### *CONUS inspectors*

There are inspectors in CONUS assigned to the U.S. Department of Agriculture's plant protection and quarantine function. These inspectors perform most or all of the aircraft inspections. However, there are some locations where only the military can provide inspectors. PH personnel at bases that are not inspected by the USDA can receive guidance and training for this activity.

You must have a plan for your base even if your base is not a port of entry. What would you need to do if a plane coming from an overseas area that did not have military inspectors had to make an emergency landing at your base? You would need to inspect the aircraft for pests.

### *Overseas inspectors*

If you are overseas and aircraft leave your base to come to the United States, you should inspect all of the cargo to be loaded and ensure that there is a 100-foot barrier zone around the aircraft (fig. 3-24). There should not be any insects or rodents in this zone, and you must use strict control measures if there are insects or rodents present. You can use baits and chemicals to form barriers or control the pests directly. Be sure the cargo is kept clean and insect-free and is stored on dunnage for easy inspection. Inspections need to be aggressive, and pest controllers with chemicals need to be handy, if necessary.

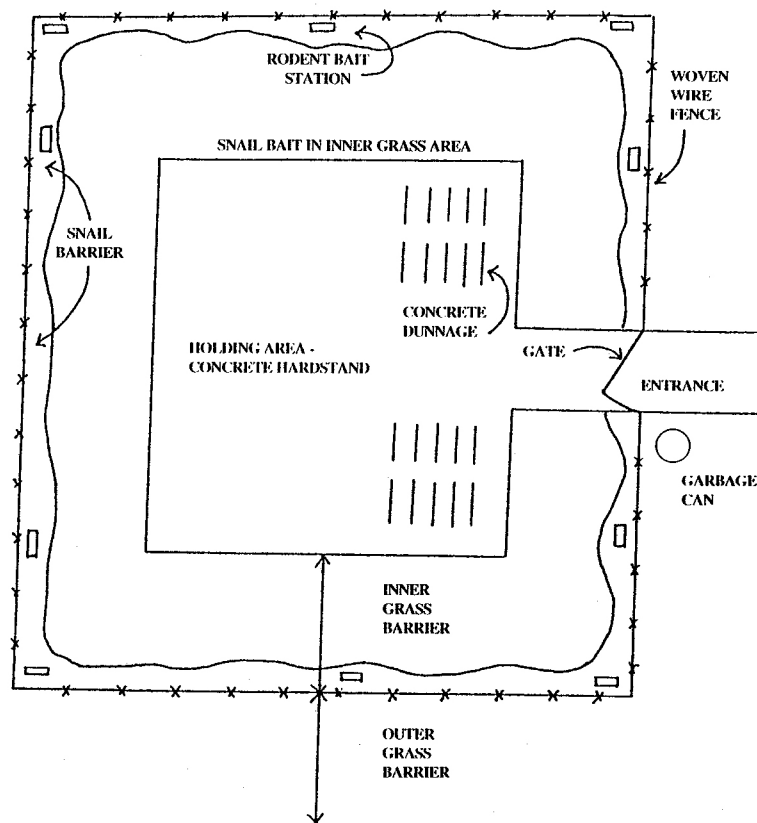


Figure 3-24. Cargo holding area with barriers.

### *Buffer zones and barriers*

There should be a 500-foot buffer zone beyond the 100-foot barrier where garbage, rodents, and ectoparasites are controlled. These barriers are around the cargo holding areas, as seen in figure 3-24.

***PH taskings***

Inspect the garbage holding areas, kitchens, and cargo holding areas for signs of the wrong items being brought into the country. Also you must ensure that wastes are emptied and tanks are cleaned and sanitized as required. (**NOTE:** You do not empty the tanks—you ensure that these tasks are performed). The basic taskings for PH are to be advisors for the overall program; to inspect when USDA inspectors are absent; and to ensure that trash, garbage, and waste products are properly managed. Research MAJCOM, base, or U.S. Customs directives for the procedures of managing waste products and inspecting aircraft.

***Administration***

If something is found that does not look right then place the aircraft on medical hold until a determination is made as to the threat and control measures necessary for the pest, plant, or animal found. Be sure to notify your NCOIC or OIC and, if necessary, the Chief, Aeromedical Services, and the MTF Commander before notifying the airfield operations director. CONUS bases usually have a USDA official to perform this evaluation; the military 4EOX1s assist when necessary if properly trained. The USDA trains 4EOs on the performance of aircraft inspections when requested. They also certify 4EOs and issue cards identifying them as augmentees to the program. Overseas, 4EOs usually perform these inspections. Local directives as well as MAJCOM directives should describe the procedures.

***Disease quarantine program***

Clearly, you need to study and understand the disease quarantine program. To do this effectively, you need a requisite knowledge of disease quarantine requirements, who is responsible for administering proper procedures, and how these procedures are administered.

***Requirements and responsibilities***

The goal of the disease quarantine program is to prevent the spread of disease from one country or state to another country or state. This program includes any form of travel such as ship or passenger jet. Since the Air Force's mission is to fly aircraft, the emphasis is placed on passenger aircraft.

***Commander's responsibilities***

The aircraft commander has the responsibility for ensuring that all passengers and crew meet the vaccination requirements for the areas they are traveling to. Anyone exhibiting symptoms of illness must be examined prior to embarking on a mission. The commander also must radio a request for a military or quarantine health inspection upon landing if any passenger or crew member shows signs of illness. If the flight originated in an area where quarantinable diseases are endemic, the request for inspection is mandatory.

***Requirements for arriving aircraft***

Any aircraft arriving from an area where quarantinable diseases are present must be met by a medical official. The job of the medical official includes questioning each person on arriving aircraft and looking for symptoms, such as fever of 100°F or more that has persisted for two days or more, a rash, jaundice, glandular swelling, or diarrhea that is severe enough to interfere with work or normal activity.

If the flight came from an area where quarantinable diseases exist, all personnel are detained until cleared by quarantine officials. If the flight came from a quarantine-exempt area, only the symptomatic person needs to be seen by a physician; the remaining passengers need to be detained only if a rash was noted on the symptomatic person. Either way, the cause of symptoms must be

determined. If an official quarantinable disease (cholera, plague, and yellow fever) is diagnosed, the quarantine officials will decide who is to be quarantined.

### ***Quarantine officials***

Requirements for flight officials are established by the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), and the U.S. Public Health Service. Quarantine officials can be either military or civilian. Usually, CONUS quarantine officials are civilian, while military members fill the overseas positions. Be sure you know who the quarantine official is at your base if you have flights arriving from out of the country.

### ***Administration***

The local base is responsible for developing the actual reporting procedures for that base. For most CONUS bases, the MTF commander or the chief of aeromedical services, has the responsibility for the disease quarantine program. At some bases, it is the flight surgeon who performs this duty. In some cases, a U.S. Public Health inspector performs the inspection. Military members overseas perform those inspections using both U.S. requirements and the host country's requirements. Local directives should address this issue.

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## **Self-Test Questions**

**After you complete these questions, you may check your answers at the end of the unit.**

### **242. Air Force Pest Management Program**

1. What organisms does the Air Force consider to be "pests"?
  
  
  
  
  
2. What form of pest control relies on changing the environment?
  
  
  
  
  
3. What is "mechanical" pest control?
  
  
  
  
  
4. Who may use "restricted use" pesticides?
  
  
  
  
  
  
  
  
  
  
5. Which type of pesticides has a low toxicity for mammals and is widely replacing all other types of pesticides?

**243. Air Force quarantine programs**

1. What is the objective of the retrograde materiel preclearance program?
2. Who has the overall responsibility for ensuring nothing harmful is transferred to another area?
3. Beyond the 100-foot barrier zone, how big is the buffer zone where garbage, rodents, and ectoparasites are controlled?
4. What are the basic taskings for PH under the retrograde materiel preclearance program?
5. What is the goal of the disease quarantine program?
6. Who has the responsibility for ensuring *all* aircraft passengers and crew meet vaccination requirements for areas they are traveling to?
7. What symptoms does an inspector look for and question travelers about?
8. What are the three *official* quarantinable diseases?
9. Who establishes the requirements for becoming a quarantine official?

**Answers to Self-Test Questions****226**

1. Prevent and control vectorborne diseases by eliminating disease vectors, reservoirs, blocking transmission of pathogens to susceptible hosts, and protecting susceptible hosts.
2. AFI 32-1053.

3. AFI 48-102.
4. Aerospace Medicine Council.
5. Pre and post-treatment vector surveillance.
6. DD Form 1532-1.
7. Provide technical information concerning the safe storage and use of pesticides and review integrated pest management plan before submission to MAJCOM/CE. BES monitors acquisition, storage, and environmental impact of pesticides for CE pest management shop, commissary, and base exchange.

**227**

1. The science of classification.
2. Class.
3. Family.
4. Family
5. Species.
6. Strain or race.
7. Exoskeleton.
8. The head, thorax, and abdomen.
9. Egg, larva, pupa, and adult.
10. A brief description of anatomical features used to identify insects.

**228**

1. *Culex*.
2. In water.
3. 50.
4. Male.

**229**

1. *Culex* and *Aedes*.
2. St. Louis encephalitis.
3. California.
4. Wild birds.
5. Breakbone fever.
6. *Aedes*.
7. Education, vector avoidance, and environmental clean up.
8. Fever, headache, backache, jaundice, and internal bleeding.
9. Falciparum, vivax, malariae, and ovale.
10. Cold, hot, and profuse sweating.
11. 10 to 16 days.
12. Falciparum malaria.
13. Vivax and ovale.
14. Doxycycline

**230**

1. Conduct a baseline entomology survey.
2. Locate them between populated areas and breeding sources, away from competing light sources, protected from wind, and approximately 6 feet above ground.
3. A net.
4. Light, CO<sub>2</sub>, or light and CO<sub>2</sub>.

5. CO<sub>2</sub> traps attract more species of mosquitoes, larger numbers of mosquitoes, fewer male mosquitoes, and fewer trash insects.
6. To catch the species of mosquitoes that are active in the late morning and early evening.
7. Weekly
8. *Aedes aegypti* and *Aedes albopictus*.
9. The average number of females caught per trap night.
10. The average number of a specific species or particular group of mosquitoes caught in a trap per trap night.

**231**

1. Cultural (environmental), chemical, and biological.
2. Filling in low lying wet areas with gravel and dirt to eliminate breeding sites.
3. Residual treatment and space treatment.
4. *Gambusia affinis*.
5. *Bacillus thuringiensis israeliensis* (BTI)
6. A combination of control techniques to prevent, eliminate, or suppress pests.
7. Residual sprays.

**232**

1. Head, body, and crab or pubic lice.
2. Epidemic typhus.
3. Germ-laden feces are scratched into the bite/wound or stuck onto fingers, which could then contaminate mucous membranes or the conjunctiva.
4. Crushed lice that are rubbed into a wound or into mucous membranes or conjunctiva.
5. Education.

**233**

1. House fly.
2. Biting flies and filth flies.
3. Biting.
4. On or by their mouthparts, through vomitus, on their body hairs, on the sticky pads of their feet, and through their feces.
5. Proper sanitation to eliminate breeding places.

**234**

1. Siphonaptera.
2. Plague and endemic typhus.
3. When crushed fleas or flea feces are scratched into the skin.

**235**

1. Hard and soft.
2. Hard.
3. Rickettsial, bacterial, spirochetal, and viral.

4. Pathogens are passed from infected adult to the eggs.
5. Use small forceps and grasp as far forward on the mouthparts as possible and carefully pull it off with an upward even pressure.

**236**

1. Larval.
2. Viral, rickettsial, and bacterial.

3. Mange, itch, and follicle.
4. Chigger.
5. Cultural, chemical, and mechanical.

**237**

1. German.
2. Pale yellowish brown or tan.
3. In commercial establishments.
4. They reproduce at a slower rate than the other species.
5. Denying access to food or moisture.

**238**

1. 21.
2. The kissing bug.
3. Hemolytic toxin, neurotoxin, urticating toxin, vesicating toxin, and hemorrhagic toxin.
4. Sting, bite, or produce fluids.
5. Vesicating toxin.
6. Avoidance.

**239**

1. House mouse.
2. Small and rod shaped.
3. Norway rat.
4. Black to slate gray; tawny above with a grayish white belly; and tawny above with a white to lemon-colored belly.
5. Sanitation and physical preventive measures.

**240**

1. Plague.
2. Bubonic, septicemic, and pneumonic.
3. Bubonic.
4. 1977.
5. By either direct or indirect contact with the urine of infected rodents or other animals.
6. Either there are no symptoms, or symptoms are mild and flu-like.
7. 40 to 50 percent.
8. The southwestern states.

**241**

1. The presence of rat or mouse feces.
2. They become dry and hard.
3. 2 to 3 inches.
4. Along walls, under boards, behind stored objects and accumulated litter, and in similar places.
5. Fresh rub marks and smears are soft when you scratch them; old ones are brittle and may flake off.
6. 1/8-inch or less.
7. Glueboard.
8. Place them into a 5-ml blood-collection vial containing 70-percent alcohol; push rubber stopper into neck of the vial; and remove the air bubble with a hypodermic needle.

**242**

1. Organisms that are in the wrong place.
2. Cultural.
3. Use of physical or mechanical methods to kill or separate pests from food source.
4. A certified applicator, or someone under the supervision of a certified applicator.
5. Pyrethroids.

**243**

1. To make sure aircraft and cargo are inspected, disinfected, and certified pest free before takeoff.
2. The installation commander.
3. 500 feet.
4. To be advisors for the overall program; to inspect when USDA inspectors are absent; and to ensure that trash, garbage, and waste products are properly managed.
5. To prevent the spread of disease from one country or state to another.
6. The aircraft commander.
7. Fever above 100°F persisting for more than two days, rash, jaundice, glandular swelling, or diarrhea severe enough to interfere with work or normal activity.
8. Cholera, plague, and yellow fever.
9. WHO, CDC, and the USPHS.

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## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to ECI (AFIADL) Form 34, Field Scoring Answer Sheet.

**Do not return your answer sheet to AFIADL.**

74. (226) Who establishes the frequency for surveying disease vectors on base?
  - a. Director, Base Medical Services.
  - b. Chief, Military Public Health.
  - c. Aerospace Medicine Council.
  - d. Centers for Disease Control.
75. (226) Who determines the need for aerial spraying of pesticides to control vectors or medically important pests?
  - a. Bioenvironmental Engineering.
  - b. Aerospace Medicine Council.
  - c. Base Civil Engineering.
  - d. Public Health.
76. (226) Who provides vector identification for bases in the continental United States (CONUS)?
  - a. Public Health at each base.
  - b. Base Civil Engineering at each base.
  - c. USAF Headquarters Entomology Support Division.
  - d. Air Force Institute for Environmental, Safety and Occupational Health Risk Analysis.

77. (227) What is the *first* classification or grouping within the animal or plant kingdom?
- Family.
  - Phylum.
  - Class.
  - Order.
78. (227) In most cases, what is the *lowest* major division in the classification system of insects?
- Order.
  - Class.
  - Species.
  - Phylum.
79. (227) Which type of metamorphosis is a growth cycle that includes four stages: egg, larva, pupa, and adult?
- Complete metamorphosis.
  - Incomplete metamorphosis.
  - Gradual metamorphosis.
  - No metamorphosis.
80. (227) Flies, mosquitoes, midges, and punkies belong to which order of insects?
- Diptera.
  - Coleoptera.
  - Siphonaptera.
  - Hymenoptera.
81. (228) Which mosquito genus deposits its eggs so they are attached together to form rafts that float on the water?
- Aedes.
  - Culex.
  - Anopheles.
  - Mansonia.
82. (228) Which mosquito larvae breathe through a pair of holes at the posterior end of the body?
- Aedes.
  - Culex.
  - Anopheles.
  - Mansonia.
83. (228) Which mosquito larvae lie parallel to the water surface?
- Aedes.
  - Culex.
  - Anopheles.
  - Mansonia.
84. (228) During which stage do mosquitoes abstain from feeding?
- Egg.
  - Larval.
  - Pupal.
  - Adult.
85. (229) The primary vectors for encephalitis are infected mosquitoes that belong to the genera
- Anopholes and Aedes.
  - Anopholes and Culex.
  - Vexan and Aedes.
  - Culex and Aedes.

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86. (229) Diagnosis of encephalitis is accomplished by
- tissue culture.
  - laboratory tests.
  - serologic sampling.
  - presumptive diagnosis.
87. (229) Which mosquitoes are vectors for dengue fever?
- Aedes.
  - Culex.
  - Mansonia.
  - Anopheles.
88. (229) Which mosquitoes transmit all four forms of malaria?
- Aedes.
  - Culex.
  - Mansonia.
  - Anopheles.
89. (229) Where do *most* complications develop when a human is infected with malaria?
- Liver.
  - Heart.
  - Brain.
  - Spleen.
90. (230) How far above the ground should New Jersey traps be located to attract the most mosquitoes?
- 2 feet.
  - 4 feet.
  - 6 feet.
  - 8 feet.
91. (230) What does the New Jersey trap use to attract mosquitoes?
- Light and Vapona.
  - Light and carbon dioxide.
  - Light and carbon monoxide.
  - Carbon dioxide and Vapona.
92. (230) Generally, how often should mosquito larvae be sampled from collection sites?
- Semi-annually.
  - Monthly.
  - Semi-monthly.
  - Weekly.
93. (230) The average number of female mosquitoes caught per trap night is referred to as the
- trap index.
  - mosquito index.
  - mosquito average.
  - New Jersey index.
94. (231) Which of the following is an example of an *environmental control* for mosquitoes?
- Filling in the low-lying areas with dirt.
  - Placing *Gambusia* minnows in the base pond.
  - Spraying the base with low doses of malathion.
  - Depositing larvacide in the stagnate water areas.

95. (231) Whose responsibility is it to recommend that low-lying areas be filled with dirt to control mosquitoes?
- Civil engineer.
  - Base commander.
  - Base medical service.
  - Local mosquito control.
96. (231) Using young dragonflies to control mosquitoes is an example of which type of pest control?
- Environmental.
  - Biological.
  - Chemical.
  - Cultural.
97. (231) Malaria is most effectively controlled during which mosquito stage?
- Egg.
  - Larval.
  - Pupal.
  - Adult.
98. (232) Approximately how many times per day do body lice feed?
- One.
  - Three.
  - Five.
  - Seven.
99. (232) How is relapsing fever transmitted?
- Bite of a louse.
  - Louse eggs laid in an open wound.
  - Feces of a louse rubbed into a wound.
  - Crushed louse germs rubbed into a wound.
100. (232) What is the *best* control method for body lice?
- Chemical.
  - Biological.
  - Personal cleanliness.
  - Regular clothes washing.
101. (233) The term “maggot” refers to which stage of fly development?
- Egg.
  - Larval.
  - Pupal.
  - Adult.
102. (233) How many ways can flies spread pathogens?
- One.
  - Three.
  - Five.
  - Seven.
103. (234) Which of the following diseases is transmitted by fleas?
- Dengue fever.
  - Leishmaniasis.
  - Malaria.
  - Plague.

104. (234) How is endemic typhus (murine typhus) transmitted?
- a. Bite of a flea.
  - b. Flea eggs laid in an open wound.
  - c. Feces of a flea rubbed into a wound.
  - d. Flea vomitus rubbed into an open wound.
105. (235) Which of the following diseases is a *bacterial* disease spread by ticks?
- a. Tularemia.
  - b. Spotted fever.
  - c. Relapsing fever.
  - d. Colorado tick fever.
106. (235) What do you call the transmission of rickettsial pathogens from adults through the egg to subsequent larval, nymphal, and adult stages?
- a. Chemical transmission.
  - b. Mechanical transmission.
  - c. Transovarial transmission.
  - d. Infection through interrupted feeding.
107. (236) How many legs do larval mites have?
- a. Two.
  - b. Four.
  - c. Six.
  - d. Eight.
108. (236) Which type of mite transmits a disease called “Tsutsugamushi disease” or “scrub typhus”?
- a. Straw-itch mites.
  - b. Follicle mites.
  - c. Rat mites.
  - d. Chiggers.
109. (237) Which species of cockroach is typically found in wet or damp basements and crawl spaces of buildings and has a very noticeable roach odor when infestations are heavy?
- a. Oriental.
  - b. German.
  - c. American.
  - d. Brownbanded.
110. (237) What is the *most effective* method of controlling cockroaches?
- a. Using insecticides.
  - b. Using roach traps/motels.
  - c. Practicing good housekeeping.
  - d. Denying access to food or moisture.
111. (238) What is the vector for Chagas disease?
- a. Snakes.
  - b. Spiders.
  - c. Scorpions.
  - d. Kissing bugs.

112. (238) Which type of venom produces raised areas on the skin that may itch or be intensely painful?
- a. Hemorrhagic toxin.
  - b. Hemolytic toxin.
  - c. Urticating toxin.
  - d. Neurotoxin.
113. (239) What size and shape are roof rat droppings?
- a. Medium sized and capsule shaped.
  - b. Medium sized and spindle shaped.
  - c. Large sized and rod shaped.
  - d. Small sized and rod shaped.
114. (239) Which is the *best* method of controlling rodents?
- a. Cultural.
  - b. Chemical.
  - c. Biological.
  - d. Sanitation and physical.
115. (240) Bubonic plague primarily affects the
- a. lungs.
  - b. heart.
  - c. lymph nodes.
  - d. blood stream.
116. (240) Which disease results from either direct or indirect contact with the urine of infected rodents or other animals?
- a. Leptospirosis.
  - b. Scrub typhus.
  - c. Tularemia.
  - d. Plague.
117. (241) Swing marks made along a beam under floor joists generally indicate the presence of which type of rodent?
- a. House mouse.
  - b. Norway rat.
  - c. Fruit rat.
  - d. Roof rat.
118. (241) If you powder a floor to survey for tracks, the *hind feet* prints of a rodent will show
- a. three toes.
  - b. four toes.
  - c. five toes.
  - d. six toes.
119. (242) Who conducts the overall entomology program within the Air Force?
- a. MTF commander.
  - b. Civilian contractors.
  - c. Public Health, with assistance from Bioenvironmental Engineering.
  - d. Base civil engineer pest management function, with assistance from Public Health.

120. (242) Which type of pest control consists of using predators, pathogens, or genetic engineering to control arthropods?
- a. Biological.
  - b. Chemical.
  - c. Cultural.
  - d. Sanitation and physical.
121. (243) Who has the responsibility for providing technical guidance, as well as qualified inspectors, to ensure aircraft are pest- and disease-free?
- a. MTF commander.
  - b. Base civil engineer.
  - c. Installation commander.
  - d. U.S. Department of Agriculture.
122. (243) The barrier zone around aircraft returning from overseas must be what size to prevent insects and rodents from boarding?
- a. 10 feet.
  - b. 25 feet.
  - c. 50 feet.
  - d. 100 feet.
123. (243) Who has the responsibility for ensuring that all passengers and crew on an aircraft meet the vaccination requirements for the areas to which they are traveling?
- a. Public health.
  - b. Base commander.
  - c. Aircraft commander.
  - d. Immunizations office.
124. (243) Which disease is *not* quarantinable?
- a. Cholera.
  - b. Plague.
  - c. Smallpox.
  - d. Yellow fever.

**Student Notes**

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## Glossary of Abbreviations and Acronyms

<b>AIDS</b>	acquired immunodeficiency syndrome
<b>AR</b>	attack rate
<b>AST</b>	aspartate aminotransferase
<b>BCG</b>	bacille Calmette-Guerin
<b>BEE</b>	bioenvironmental engineering
<b>CDC</b>	Centers for Disease Control
<b>CE</b>	civil engineer
<b>CNS</b>	central nervous system
<b>CSF</b>	cerebrospinal fluid
<b>DHF</b>	dengue hemorrhagic fever
<b>DNA</b>	deoxyribonucleic acid
<b>DSS</b>	dengue shock syndrome
<b>DTH</b>	delayed tuberculin hypersensitivity
<b>EEE</b>	eastern equine encephalitis
<b>EIA</b>	enzyme-linked immunosorbant assay
<b>ELISA</b>	enzyme-linked immunosorbant assay
<b>FTA-ABS</b>	fluorescent treponemal antibody-absorption test
<b>HAV</b>	hepatitis A virus
<b>HBIG</b>	hepatitis B immunoglobulin
<b>HBV</b>	hepatitis B virus
<b>HCP</b>	health care provider
<b>HDCV</b>	human diploid cell vaccine
<b>HIB</b>	Haemophilus influenza B
<b>HIV</b>	human immunodeficiency virus
<b>HSV</b>	herpes simplex virus
<b>HSV1</b>	herpes simplex virus type one
<b>HSV2</b>	herpes simplex virus type two
<b>ICO</b>	infection control officer
<b>IG</b>	immune globulin
<b>IGR</b>	insect growth regulator
<b>INH</b>	Isoniazid
<b>IPM</b>	integrated pest management

<b>IR</b>	incidence rate
<b>LFT</b>	liver function test
<b>LGV</b>	lymphogranuloma venereum
<b>MHA-TP</b>	microhemagglutination assay for <i>T. pallidum</i> antibodies test
<b>MIQ</b>	Military International Quarantine Program
<b>MQI</b>	military quarantine inspection
<b>MTF</b>	medical treatment facility
<b>NER</b>	noneffectiveness rate
<b>NGU</b>	nongonococcal urethritis
<b>PH</b>	public health
<b>PID</b>	pelvic inflammatory disease
<b>PPD</b>	purified protein derivative
<b>RBC</b>	red blood cells
<b>RIA</b>	radioimmunoassay
<b>RIG</b>	rabies immune globulin
<b>RNA</b>	ribonucleic acid
<b>RPR</b>	Rapid Plasma Reagin Circle Card Test
<b>STD</b>	sexually transmitted disease
<b>TI</b>	trap index
<b>TOC</b>	test of cure
<b>TST</b>	tuberculin skin test
<b>TTT</b>	tuberculin tine test
<b>TU</b>	tuberculin units
<b>ULV</b>	ultra low volume
<b>USDA</b>	United States Department of Agriculture
<b>VDRL</b>	Venereal Disease Research Laboratories
<b>WBC</b>	white blood cells
<b>WEE</b>	western equine encephalitis

## **Student Notes**

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